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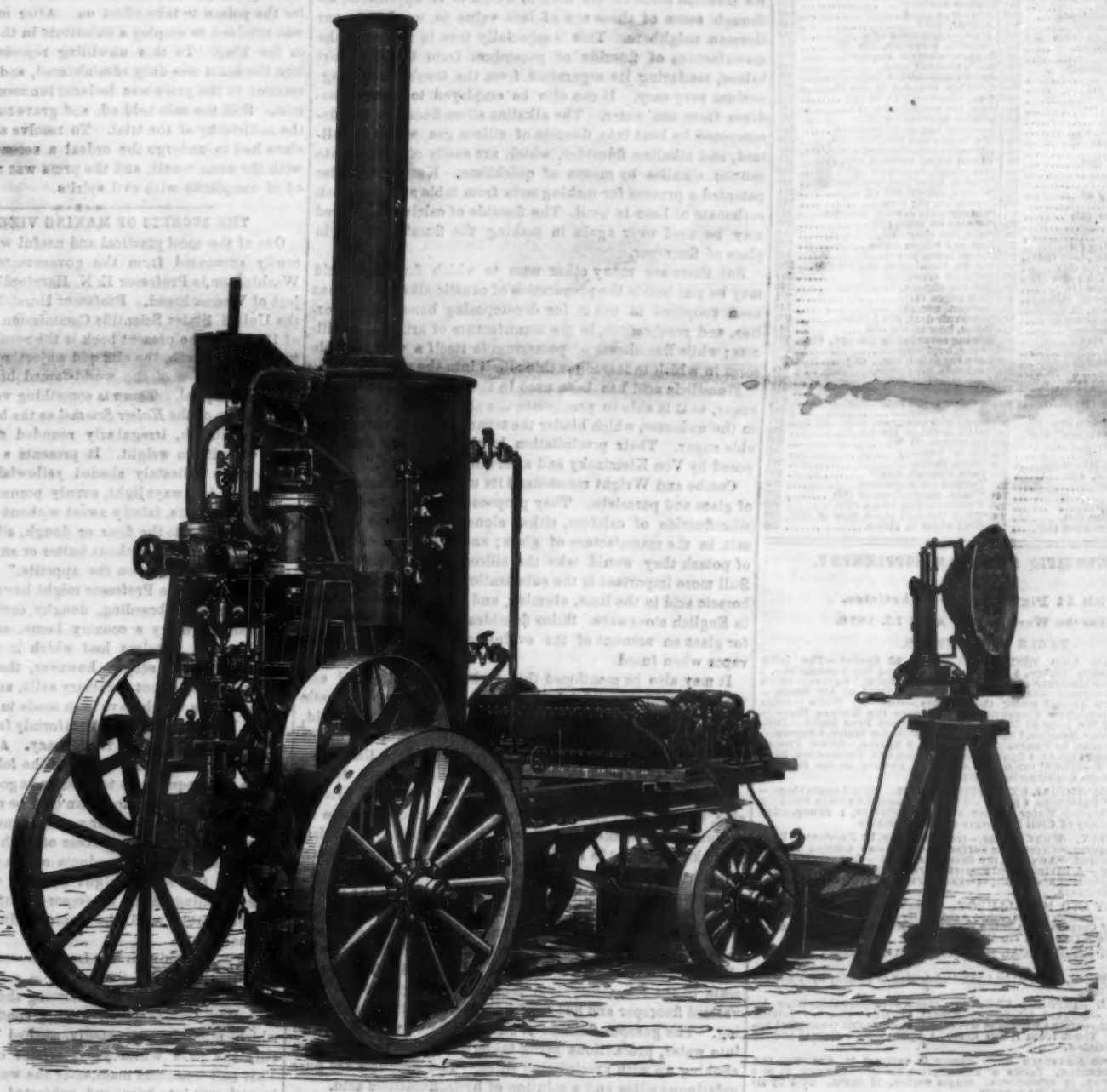
A LOCOMOTIVE MAGNETO-ELECTRIC INDUCTION ENGINE.

We recently published Professor G. F. Barker's excellent lecture on magneto-electric machines, in the course of which a description was given of the Siemens armature. One of the most recent applications of this important apparatus for converting magnetism into electricity is represented in the accompanying engraving, which we take from the *Practical Magazine*. The machine is a locomotive magneto-electric induction engine, in other words a very powerful electrical battery, mounted on a carriage, to which horses may be harnessed in order to transport it from place to place. The fore part of the vehicle is occupied by the magneto-electric apparatus, which is driven by a small vertical steam engine located in the rear. The machine was built at the Siemens-Halske telegraph works, in Berlin, and is mainly intended for the production of the electric light.

Currents of electricity are induced in coils of insulated wire wound upon a metal drum, by causing the latter to rotate rapidly around an iron core placed between powerful magnets The electric current can be conducted, either continuously or intermittently, to any desired point, by means of conductors connected with the magnetic poles. When used for illuminating and signaling purposes, the conductors are led to an electric lamp, which is provided with a special arrangement for regulating the intensity of the current. The steam boiler is vertical, made of steel plate, with a fire box suspended below; there are twin cylinders, which set in motion a couple of driving wheels, connected, by means of belting (omitted in the figure), with the drum of the induction apparatus

The engine works up to 200 revolutions per minute, producing 450 revolutions per minute of the drum of the induction apparatus. The latter is of thin German silver plate, covered with eight separate coils of copper wire of 0·28 inch gage, and rotates between two very powerful horseshoe magnets. At full speed, the current induced is sufficiently intense to heat a copper wire, 0 04 inch in diameter and 38 feet long, to redness, and, photometrically, is equal to 14,000 wax candles. The draft of the apparatus is about 2½ tuns.



PORTABLE MAGNETO-ELECTRIC MACHINE

The Use of Well Water in the Cities.

The State Geologist of New Jersey, in his recent report, calls attention to the habit, still in use in some of the older cities of New Jersey, of people drawing their supplies of water from old wells. In an analysis of the water coming from some nine wells in Princeton, five of them were found to contain free ammonia, albuminous matter, and chlorides in excess. In tracing the effects of these waters, it was found in almost all cases that diarrhœa and typhoidal fevers accompanied their use. It is almost impossible to be sure of the good quality of any well which is surrounded by houses, where drains and sinks empty into the surrounding soil. It would be well if the proprietors of large country hotels and summer resorts would not only look more closely to their sources of water, but eschew well water entirely. For the health of their guests, it is better, in all cases where running water does not exist, to seek their source of water from cisterns which are fed from the rainfall on the roofs. Wherever such rain water is used, it may be safely stated that there is an entire exemption from the diseases which always attend the use of water contaminated with putrefying organic matter

An Incendiary Machine.

The Hartford Phœnix Insurance Company lately unearthed the latest incendiary device in connection with an $1,800 barn loss in Schoharie county, New York. It is to be hoped that the machine will form a part of the underwriters' Centennial exhibit. The apparatus consists of a board covered with sand paper that faces another board filled with matches, set so that the sulphur of the matches can rub against the sand. These were set against a hay mow, and with the match-filled board attached to a ten foot lever with its bearing in the middle. At the end of the lever is a tin milk pail, and set above the pail was an ordinary funnel supplying the bottom to a bushel box filled with fine sand. This sand was allowed to run into the pan; and when the pressure was sufficient to move the lever, a string unloosed the funnel, and the balance of the sand, dropping suddenly into the pan, moved the lever, and so the board ignited the matches, thus firing the barn. A belated traveler passing discovered the thing in working order, rushed in, and saved it, and presented it to the insurance adjuster as an evidence of the ingenuity of man.

An excellent varnish for photographic negatives is made of 3 ozs. bleached shellac dissolved in 24 ozs. alcohol. Filter when dissolved, which will be in 1 or 2 days, then add gum sandarac 1 oz., essential oil of lavender 1½ ozs. Filter again and bottle for use

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NEW YORK, SATURDAY, APRIL 15, 1876.

Contents.

(Illustrated articles are marked with an asterisk.)

Acalypha marginata*..... 247
Air, purity of the (39)..... 250
Alloys for repairing valves (28)..... 250
Alloys resembling gold (32)..... 250
Amenities, editorial..... 241
Answers to correspondents..... 250
Architectural studies (45)..... 251
Arkansas diamonds, to dress (31)..... 250
Armor plate, the thickest..... 247
Bells, alarm (59)..... 251
Belting, something about*..... 244
Belts, width of (9)..... 250
Boats, engines, etc. (8)..... 250
Boiler plug, fusible*..... 246
Boilers, blacking for (11)..... 250
Boilers, testing*..... 246
Bread, making Vienna..... 240
Business and personal..... 250
Cards, soiled (37)..... 250
Cars, early sleeping (58)..... 251
Chilblains, to cure..... 248
Cisterns, natural..... 248
Coal, early discovery of..... 247
Coal tar paints (26)..... 251
Copyright in articles (33)..... 251
Desk, improved*..... 246
Diamonds (46)..... 251
Earthenware, glazing (34)..... 251
Earth is weighed, etc., how the*..... 248
Electric coils, wires for (54)..... 251
Engineers in New York city (38)..... 250
Engines, high and low (7)..... 250
Engines, proportions of (13)..... 250
Engines, speed of, etc. (2, 3, 14)..... 250
Exhibition, the international..... 241
Experiment, new lecture*..... 244
Feathers, cleaning (47)..... 251
Feed water heater*..... 242
Fiber plant, the baobab..... 240
Fish, canning (35)..... 251
Fluosilicic acid in the arts..... 240
Glass cylinders, blowing (40)..... 251
Glass, ruby-colored (19)..... 250
Gourd, an ornamental*..... 247
Gun barrel, magnetism in a (55)..... 251
Gyroscope, simple form of the*..... 244
Hardening wire (1)..... 250
Heating by steam (12)..... 250
Human remains in Michigan..... 244
Incendiary machine, an..... 239
Induction coils (50)..... 251
Ink, a river of..... 248
Ink, blue black (30)..... 250
Ink, indelible Indian (25)..... 250
Ink, indelible, to remove (42)..... 251
Iron, expansion of, etc. (18)..... 250
Iron sticking to linen..... 248
Kerosene flames (15)..... 250
Kerosene, hose for (20)..... 250
Kitchen cabinet*..... 243
Lacquer, a good..... 242
Lacquer, gold..... 240
Lathe, proportions of a..... 250
Magnetic meridian, the (57)..... 251
Magneto-electric engine*..... 239
Man's allotted span..... 242
Match composition (44)..... 251
Meridian, changes in the (6)..... 250
Mica, electricity from (21)..... 250
Mica, the utilizations of..... 241
Mildew, preventing (27)..... 250
Mucilage bottle, improved*..... 246
New books and publications..... 248
Nitro-glycerin, dynamite, etc. (48)..... 251
Oil and water volatile, etc. (43)..... 251
Parchment, colors on (22)..... 250
Patents, American and foreign..... 248
Patents, official list of..... 251
Pavement, pig iron..... 242
Photographic carbon process..... 242
Pictures on glass (19)..... 250
Plant, the time to..... 242
Plus and minus signs..... 250
Pump, horse power..... 248
Pumps, locomotive and air (16)..... 250
Railroad crossings..... 247
Railway signals, improved*..... 246
Rain gages (42)..... 251
Recipes, useful..... 243
Reservoir dam, the Lynde..... 248
Roses, how to set out..... 242
Sewing machine in Europe, the..... 243
Snake, a spitting..... 248
Soap for toilet, etc., (32)..... 250
Soapsuds, save your..... 242
Soap, testing (60)..... 251
Spectrum of the electric arc..... 242
Spectrum, the magnetic*..... 244
Spring power..... 244
Study and business..... 247
Sun's distance, the (4)..... 250
Tellurium (24, 26)..... 250
Tin in Tuscany..... 242
Trees, shade..... 251
Tube cleaner, steel*..... 248
Varnish for negatives..... 239
Water, electrolysis of (53)..... 251
Waterproofing boots (20)..... 250
Water through pipes, flow of (10)..... 250
Well water in cities..... 239

THE SCIENTIFIC AMERICAN SUPPLEMENT.

No. 16.

With 51 Figures and 60 Articles.

For the Week ending April 15, 1876.

TABLE OF CONTENTS.

I. ENGINEERING AND MECHANICS. With 32 figures.—The Jetty Works, Galveston Harbor, 5 figures.—New Method for Foundations, 1 figure.—Milling Machines and Tools, by JOSHUA ROSE, 7 figures.—Ihle's Differential Compass.—Bang's Water Works.—Trial of Air Brake.—Proposed New Tunnel under the Thames.—Gunnery Trials.—Amateur Mechanics.—New Suspension Bridge over the Hudson River.—Deepening of the Beds of Rivers.—San Francisco Free Baths.—Drilling and Slotting Machine, 1 figure.—Richards' Water Meter, 5 figures.—Shaping Machines, by PROFESSOR MACCORD, 9 figures.—Screw Propellers, by N. D. SPARTALI, 4 figures.—Evaporation and Percolation, by C. GREAVES, C. E.—The 81 ton Gun.—Action of Powder on the Bores of Guns.—Ironwork Construction in 1875.

II. THE INTERNATIONAL EXHIBITION OF 1876. With 3 engravings.—The Brewers' Exhibition, 1 figure.—The New Hampshire State Building, 1 figure.—The Feed Water Heater at the Exhibition, 1 figure.—The American Society of Civil Engineers at the Exhibition.

III. TECHNOLOGY. With 6 figures.—Iron Assaying, by PROFESSOR BRUNO KERL, 5 figures.—Crystalline Surfacing of Metals.—Cutting Steel by Means of Soft Iron.—Award of the Bessemer Medal.—Remarkable Cable Telegraphing.—A Divining Rod Expert.—Cremation in Milan.—Natural Gas, its Composition and Transportation.—Product of Steel.—Changing Methods of Business.

IV. CHEMISTRY AND METALLURGY.—Chemical Substances Obtained from Plants.—Action of Sulphuric Acid on Hydrogen Carbides.—Anethol.—Use of Cerium for Aniline Blacks.—Spectra of Nitrogen and Alkaline Metals.—Temescal Tin Mines.

V. LESSONS IN MECHANICAL DRAWING. By PROFESSOR MACCORD. 8 figures.

VI. AGRICULTURE, ETC.—The Chemical Action of Plants, by PROFESSOR A. VOGEL.

VII. NATURAL HISTORY, ETC.—Sea Cows.—Remarkable Blow by Sword Fish.—Largest Goniatite.—Ascent of Mont Blanc.—Walking and Training.—Brain Changes in Hydrophobia.—London Geological Society.—New Trout from Kern River, 1 figure.—New Guinea and the Admiralty Islands.

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A GOLD lacquer closely resembling the real Chinese article is made by first melting to a perfectly fluid mixture 3 parts copal and 1 part shellac. To this add 2 parts good boiled oil. Remove the vessel from the fire, and gradually mix in 10 parts oil of turpentine. To give color, add a solution of gum gutta in turpentine for yellow, or of dragon's blood for red, a sufficient quantity of coloring material being used to give the desired shade.

FLUOSILICIC ACID IN THE ARTS.

One of the compounds of silicon with hydrogen and fluorine, known as hydrofluosilicic acid, $H_2 Si F_6$, seems likely to become at some future time as useful and well known as it is now rare and untalked-of. It is not a new substance, but has long been used in analytical laboratories for precipitating potassium, one of the most difficult salts to precipitate; and also it is used for separating barium from calcium and strontium. About eight years ago, Tessié du Motay and E. Karcher attempted its manufacture on a commercial scale at Grossblittersdorf; but the Franco-Prussian war interrupted the business, which has never been revived. Their process consisted in smelting together in a shaft furnace, by means of a cold blast, a dry mixture of sand, clay, fluorspar, and fine coke. The gases evolved, consisting chiefly of nitrogen, carbonic oxide, carbonic acid, and fluoride of silicon, were passed through water in a condensing apparatus, when the fluoride of silicon was decomposed into silicic acid and hydrofluosilicic acid. The acid solution was either introduced into commerce in that form, or employed in preparing silico-fluoride of potassium and sodium. This process was quite imperfect, and, until a better one is devised, the manufacture of fluosilicic acid on a large scale is not likely to be revived. In the first place, not all the fluoride of silicon is decomposed by the water, and this involves a waste; secondly, some hydrofluoric acid is formed, which cannot be expelled, and this interferes with its usefulness in decomposing the chlorides of potassium and sodium. Finally, the silico-fluorides of potassium and sodium, when formed, are not completely decomposed by heat into fluoride of silicon and alkaline fluorides.

That it is highly desirable to devise a cheap and perfect method of manufacturing fluosilicic acid will be seen when we mention some of the uses to which it is applicable, although some of these are of less value to us than to our German neighbors. This is especially true in regard to the manufacture of fluoride of potassium from the Stassfurt brines, rendering its separation from the troublesome magnesium very easy. It can also be employed to separate sodium from sea water. The alkaline silico-fluorides are decomposed by heat into fluoride of silicon gas, which is utilized, and alkaline fluorides, which are easily converted into caustic alkalies by means of quicklime. Kessler has also patented a process for making soda from table salt, in which carbonate of lime is used. The fluoride of calcium produced may be used over again in making the fluosilicic acid, in place of fluorspar.

But there are many other uses to which fluosilicic acid may be put beside the preparation of caustic alkalies. It has been proposed to use it for decomposing bones, phosphorites, and sombrerites, in the manufacture of artificial fertilizers; while fluosilicate of potassium is itself a very suitable form in which to introduce this alkali into the soil.

Fluosilicic acid has been used in the manufacture of beet sugar, as it is able to precipitate the alkaline salts contained in the molasses, which hinder the separation of the crystallizable sugar. Their precipitation by this acid was first proposed by Von Kletzinsky and afterwards by Marix.

Combe and Wright recommend its use in the manufacture of glass and porcelain. They propose to replace the lime by silicofluoride of calcium, either alone or with the barium salt, in the manufacture of glass; and instead of carbonate of potash they would take the silicofluoride of potassium. Still more important is the substitution of fluosilicic acid for boracic acid in the lime, alumina, and other compounds used in English stoneware. Silico-fluorides could scarcely be used for glass on account of the evolution of fluoride of silicon vapor when fused.

It may also be mentioned that it has been proposed and used in making artificial stone, for fixing stereochromatic colors, in making tartaric acid, as a substitute for this acid, as a mordant in dyeing and calico printing (in place of the drug bath), for whitening pins, for removing the lime from beet juice in making sugar, and many other uses. It produces an incomparably beautiful patina on brass, bronze, zinc, and German silver. A French manufacturer uses its sodium salt to make hard alloys rich in silicon. T. Christy has taken a patent in England for its use in the manufacture of ammonia from gas liquor.

It seems as if fluosilicic acid, notwithstanding the service it has already rendered, is not attracting the attention it deserves either from chemists or manufacturers. Let America take hold of the problem and show the old world what she can do with this curious and useful acid. On a small scale in the laboratory, it is made by mixing together pulverized fluorspar and fine sand, adding oil of vitriol, and heating. The gaseous fluoride of silicon thus formed is passed into water, precautions being taken to prevent the tube from choking up with precipitated silica. The products are pure gelatinous silica and a solution of hydrofluosilicic acid.

THE BAOBAB AS A FIBER PLANT.

The baobab (*Adansonia digitata*) has long been known as one of the giants of the vegetable kingdom. It has lately become an important source of fiber for papermaking. The fitness of its inner bark for this purpose was demonstrated some years ago, but it is only within the past decade that it has begun to rank as an important article of commerce. By the natives of Africa the bark is put to various uses: Twisted into string and rope, it is used for all sorts of purposes, and in untwisted strips it serves to secure loads and to bind together the poles employed in making their huts. Finer pieces are pulled out so as to resemble coarse netting; and the edges being sewn together, they make handy bags for cotton, gum, grain, and the like. Coffee and ground nuts are brought down from the interior to the coast in very strong bags woven from thin strips of the bark.

The bark is obtained by first chopping off the softer outer bark of the tree with a hatchet, after which the inner bark is stripped off in large sheets. The pieces are beaten with a stick to soften them, and shaken to get rid of some of the pithy matter which they carry. The sap is then dried out in the sun, and then the fiber is pressed into bales for shipping. The smaller trees produce the finest and softest fibers. The bark is taken off all round the tree, which does not appear to suffer much injury. A fresh layer of bark grows and is thick enough to be taken off in six or eight years. Mr. J. J. Monteiro, who has the credit of adding this valuable fiber to the resources of the paper trade, tells some amusing stories of the difficulty he experienced in developing the business of collecting the fiber. By paying liberally, he induced some of the natives to take hold of the new work at last, and matters went on tolerably smoothly until a season of drouth came on. The fetich men declared that the "big iron"—his hydraulic press—had fetiched the rain and prevented its appearance. The matter was discussed throughout the country; and at a general meeting of the people of the neighboring towns, it was decided to apply the usual tests to the big iron, and, if it proved to be a sorcerer, to destroy the press and throw it into the sea. It is the custom in those parts to try all cases of supposed witchcraft by subjecting the suspected to the ordeal of poison. For this purpose they use *casca*, the bark of a large tree, the *erythrophlæum Guineensis*, which acts either as a violent emetic or as a purgative, innocence or guilt being determined by the manner of its action.

In the case of the press, the application of this simple and, to them, perfectly satisfactory test was seriously interfered with by the absence of any stomach or insides to the big iron, for the poison to take effect on. After much deliberation it was resolved to employ a substitute in the person of a slave to the king. To this unwilling representative of the big iron the *casca* was duly administered, and luckily acted as an emetic; so the press was declared innocent of bewitching the rain. Still the rain held off, and grave suspicions arose as to the sufficiency of the trial. To resolve all doubts, the poor slave had to undergo the ordeal a second time, fortunately with the same result, and the press was never more suspected of complicity with evil spirits.

THE SECRETS OF MAKING VIENNA BREAD.

One of the most practical and useful works which has recently emanated from the government printing office, at Washington, is Professor E. N. Horsford's report on the subject of Vienna bread. Professor Horsford was a member of the United States Scientific Commission to the Vienna Fair of 1873; and the present book is the result of careful and exhaustive research, the aim and object of which was to unearth the secret of the world-famed bread peculiar to the Austrian capital. There is something very appetizing in his description of the *Kaiser Semmel*, as the bread is there termed. It is "a smooth, irregularly rounded small wheaten flour loaf, of uniform weight. It presents a rich reddish brown crust and a delicately shaded yellowish, almost white, interior. It is always light, evenly porous, free from acidity in taste or aroma, faintly sweet without the addition of saccharine matter to the flour or dough, slightly and pleasantly fragrant, palatable without butter or any form of condiment, and never cloying upon the appetite."

The reverse, the Professor might have added, on one hand, of the dyspepsia-breeding, doughy compound which passes for bread in many a country home, and of the attenuated, alum-treated, tasteless loaf which is produced in many a city bakery. It seems, however, that these gastronomic abominations are not necessary evils, and that, despite the repeated efforts which have been made to imitate Vienna bread out of Vienna, which have uniformly failed, a way does exist of producing it in all its delicacy. And that way is very simple, as the reader will see by the following:

The first requisite is to procure as good flour as the Vienna bakers have. Good flour can only be made from pure sound wheat, and by good milling. This means in general flinty wheat reduced by the process of high or half high milling, and a selection of the products of the milling, not to exceed one half the total weight of the wheat ground. Good fresh middlings flour, Professor Horsford says, would compare favorably with the average Hungarian flour used in Vienna.

The next requirement is fresh pressed yeast. This is already made in the United States. It is not difficult to manufacture, since it is made by skimming the froth from beer mash in active fermentation. This contains the upper yeast, which must be repeatedly washed with cold water until only the pure white yeast settles clear from the water. This soft tenacious mass, after the water has been drawn off, is gathered into bags, and subjected to hydraulic pressure until there remains a semi-solid, somewhat brittle, dough-like substance, still containing considerable water. This is the pressed yeast, which will keep for eighty days in summer and for an indefinite time on ice. For use it should be of recent preparation and sweet, so that it will yield only alcohol and carbonic acid as products of fermentation.

Next follows the very important operation of mixing. Into the middle of a zinc-lined trough, about 2½ feet wide and 8 feet long, semicylindrical in form, the Vienna baker empties his flour sacks. Then, into a pail holding about five gallons, equal parts of milk and water are poured, and left to stand until the mixture attains the temperature of the room, between 70° to 80° Fah. It is then poured into one end of the trough and mixed with the bare hand with a small portion of the flour to form a thin emulsion. The press yeast is

next crumbled finely in the hands, and added in the proportion of three and a half ounces to every three quarts of liquid, and then one ounce of salt in same proportion is diffused through the mixture. The trough is now covered and left undisturbed for three quarters of an hour. Then follows the incorporation of the flour from the neighboring heap; and as this is the last of the ingredients, we may write the recipe as a whole, thus: Flour 8 pounds: milk and water 3 quarts: pressed yeast 3½ ozs.: salt 1 oz.

The mass of dough, being left quiet for two hours and a half, becomes a smooth, tenacious, puffed mass, of yellowish color, which yields to indentation without rupture and is elastic. It is now weighed into pound masses, and each lump is then cut by machinery into twelve small pieces, each of three quarters of a inch in thickness. Of each one of these, the corners are brought together in the center and pinched to secure them. Then the lump is reversed and placed on a long dough board for further fermentation, until the whole batch is ready for the oven. Before being introduced into the latter, the rolls are again reversed and restored to their original position, having considerably increased in volume, to be still farther enlarged in the oven to at least twice the volume of the original dough. In the oven they do not touch each other, and the baking occupies about fifteen minutes. To glaze the surface they are touched in the process of baking with a sponge dipped in milk, which, besides imparting to them a smooth surface, increases the brilliancy of the slightly reddish cinnamon color and adds to the grateful aroma of the crust. No peculiar form of oven is required, the only necessary point being that the receptacle shall be capable of maintaining a temperature of about 500° Fah.

THE UTILIZATIONS OF MICA.

A correspondent encloses us a sheet of very clear mica, and asks us for what the material may be employed. Of late, large quantities of mica have been mined in Mitchell and adjoining counties, in North Carolina, which are proving very remunerative. The material is got out in sheets of from two by three to fifteen inches square, according to patterns furnished by dealers, and the best price is given for dark or brandy-colored mica. In obtaining these sheets, of course, immense quantities of scraps and fragments must be made, and it is mainly with regard to these waste bits that the utilizations above to relate. The first employment which suggests itself as worthy of a wider field than it now possesses is the substitution of mica for glass in spectacles worn by workmen, especially stone and metal workers, to protect their eyes from chips and splinters. As already made in Germany, these mica glasses are concaved in the shape of watch glasses, and are about one twenty-fifth of an inch in thickness. They are mounted in simple brass wire frames, and are made sufficiently large to fit closely around the eye sockets. The advantages gained by this utilization are greater than would at first be imagined. Mica spectacles cannot be broken. Pounding with a sledge hammer merely flattens them, nor does molten metal poured on the mica affect it. The shower of pointed iron particles which issues from lathes merely rebounds from the elastic mica glasses. In weight, mica spectacles are about half as heavy as glass ones; and when a pure material is used, the mica, with the exception of a slight grayish tint, which is rather agreeable to the eye, is fully as transparent as glass.

Another use for mica is its application, when previously colored or metallized, to ornamental purposes. From its unalterable nature, the material preserves gilding, silvering or coloring from deterioration; and from its diaphaneity, the articles so treated will preserve all their brilliancy. The process of treating mica, devised by Murray, of Paris, is as follows: The mineral is first cut to the desired thickness, then coated with a thin layer of fresh isinglass diluted in water, and the gold or other surface applied, after which it is allowed to dry. A copper pattern of the desired design is next placed on the reverse side of the sheet, and any superfluous parts of the gilding are removed by means of a small brush, the design remaining on the parts not brushed. Colors are then laid on as desired, and the whole is coated with a solution of liquid glue, diluted in spirits of wine, which is applied for the purpose of rendering the mica pliable. The sheet is then fastened with glue permanently in position; and where several sheets are to be secured together, the junction can be rendered imperceptible by first gluing with Venetian glue and then going over the joints with a hot iron.

Puscher, of Nuremberg, has also suggested several ways of converting mica sheets into very elegant ornamentation. For one application the thin plates are first purified by treatment with strong sulphuric acid, and then silvered by the ordinary process adopted with looking glass. The mica thus acquires a beautiful silver luster, and it may easily be cut into any shape for inlaying work. The flexibility of the mica will, of course, allow of its being applied to irregular surfaces. When a sheet of mica is heated to full redness for a time, in a clay muffle, it loses most of its flexibility, and is changed considerably in appearance. Under reflected light, it has a dead silver white look; but viewed by transmitted light, it is seen covered with gray spots. This latter appearance is lost when two or three pieces are superposed. The mica, after heating, is also a beautiful material for inlaying work; it should be cut into the desired shapes prior to the heating process. Another very pretty effect is obtained by scattering small fragments of mica on freshly poured clear sheets of gelatin, and varnishing it with a dark-colored solution of gelatin. Finely ground mica, on colored gelatin, also shows handsome effects; and when mixed with a solution of gum arabic, it makes a good silver ink. The gelatin combination is used for inlaying buttons.

Another beautiful application of mica is in the production of bronze-like colors, which bear the names brocades crystal colors, and mica bronzes. The mineral is to this' end well crushed, boiled in hydrochloric acid, then washed in water, and assorted according to the size of the lamina. Mica scales thus obtained exhibit a glass-like luster, combined with a silver white appearance. Among the advantages of these brocades are that they are indifferent to sulphurous exhalations, are very light in weight, and in some colors are even more brilliant than the metal bronzes. They may be fixed upon all kinds of articles of metal, wood, glass, plaster of Paris, and paper board, so that they are well adapted to the preparation of artificial flowers, fancy papers, sealing wax, and for use in tapestry, furniture-making, and painting: in fact, they may be applied to all purposes now filled by ordinary bronze powders. In fixing these brocades, the articles are first painted in bronze color; if silver is to be imitated, a ground of white lead is suitable. Either oil or glue color may be used, the latter fixed with a mixture of 4 parts glue and 1 part glycerin. Upon this coat, when hard, the binding material for the brocade is spread, and after fifteen minutes the latter is sifted over. As a binding material, a paste consisting of 4 parts boiled starch and 1 part glycerin is recommended. If the ground is formed by an oil paint, the binding material for the brocade should be constituted of pale copal varnish, upon which, when only pitchy, the powder is sifted. When finally varnished, articles treated as above assume a very beautiful appearance.

When small particles of mica silver are spread over articles coated with asphalt varnish, the result is a good imitation of granite. The crystal colors are also suitable for calico-printing; and fabrics to which they are applied surpass in brilliancy the heavy bronze and glass dust fancy fabrics of Lyons. Such colors have been used to decorate porcelain and glassware, the articles undergoing a second heating up to the fusing point of their glazing. By suitable dyes, the material is easily colored to a variety of hues.

Mica has been used instead of glass on board war vessels, in localities where glass would be broken by the concussion due to the firing of heavy guns. It is also employed for roofing purposes, and in several patented processes forms a water and fireproof covering for strata of rubber, tar, canvas, felt, and similar materials.

THE INTERNATIONAL EXHIBITION OF 1876—PROGRESS OF THE MACHINERY DEPARTMENT.

The commencement of the period of hustle and tussle, such as has been more than once predicted in these columns, is at hand; and Machinery Hall and its offshoots are now a very pandemonium of iron, wood, brick, stone, and mortar, in every conceivable shape and position. Heaped up in the most indiscriminate manner may now be seen monstrous castings and forgings, belonging to such mighty engines as steam hammers, rolling mills, etc.; and they lie about the floor in a manner as though some Titan, in mockery of all human effort, had carelessly dropped the ponderous objects in this way to thwart the toiling mites who tug at them all the day to bring them into place; and one might pass on in the full conviction that busy man had here overreached himself in his attempt to master these unwieldy masses and bring order out of such a chaos by the 10th of May, if it were not for those modern and veritable titanic aids, the steam cranes, three of which are now constantly at work lifting and moving heavy objects into place. One of these machines picks up a 10 tun piece of iron and whirls about upon its vertical axis with it, to deposit it where wanted, or moves off to the desired spot with the piece of metal hanging from its extended arm, with all the ease imaginable. Much of this kind of material as there now is upon the floor, car load upon car load continues to arrive almost hourly. As an earnest of what may be expected within the next two weeks, it may be stated that eighty car loads of material arrived upon the grounds on Saturday last. In view of such facts, we may well believe that, before the whole is in its destined place, many figurative corns will be trod upon and some peculiarly centennial anathemas be added to the language. Mixed up with such ponderous objects as the foregoing may be seen, here and there, a fancy little show case occupying its half dozen square feet of floor, and others of greater size and pretensions looming up in all their majesty of polish, gilding, and ornate carving; and one is led to wonder how their present high state of finish is to be preserved amid an assemblage which may be described as the furniture of some huge smithy.

Some of the "early birds"—to whom we give all credit—have their exhibits finished, and they can look on at their more tardy *confrères* with all the complacency of a man with an umbrella among his friends caught out in a heavy shower without any. Among these is a rather peculiar exhibit—and one which will become quite a prominent landmark in the hall—made by J. H. Mitchell, of Philadelphia. It consists of a column erected upon an ornamental pedestal of brick, the whole being about thirty feet in hight. The plinth, base, a section of the shaft at about every four inches, and the members of the capital, are each made of a separate grindstone, the whole being proportioned so as to form a very handsome column of the Doric order of architecture, every piece—of which there are thirty-six—being a real grindstone, except the plinth and the upper member of the capital, both of which are, of course, square, and could not therefore well be used for grinding purposes. These stones are of all shades of color, and come from all parts of the world where such material is found; altogether, this column makes a conspicuous and curious object.

Another of the American exhibitors who has taken time by the forelock is the firm of J. P. Morris & Co., of this city, who have now erected, at a short distance westward of the large Corliss engines, an immense vertical blowing engine. With the exception of a very few of the minor details, it is now complete; and from its great hight and massive proportions, it may readily be seen from almost any part of the floor of the great building. The steam cylinder is 50 inches in diameter by 7 feet stroke, and the air cylinder is 90 inches in diameter, with the same stroke. It is of the style generally known as the "steeple," with the air cylinder placed vertically upon the steeple frame. The axes of the cylinders are in one line, and the piston rods are severally connected to a yoke, which encompasses the crosshead, the rod of the air cylinder passing upward, and that of the steam cylinder downward. The whole hight of this machine is 37 feet 6 inches above the floor, and its total weight over 100 tuns. It is a condensing engine, but will be run (without pressure in the air cylinder) during the exhibition as a high pressure or non-condensing engine, at about 16 revolutions per minute, discharging into the upper regions of the building nearly 10,000 cubic feet of air per minute, which ought to render the immediate vicinity of this engine a favorite locality during the heated term, which we are sure of in the months of July and August. Upon either end of the shaft, which is below the bottom cylinder head, is a massive fly wheel of 20 tuns weight, which is, in some respects, quite notable. The hubs or centers of the wheels are somewhat larger than in the ordinary constructions of this kind, sufficiently so as to permit of the crank pin being inserted into them as in the ordinary disk crank. These hubs or centers have holes bored radially in their edges for the reception of the arms of the wheel; and each arm, cast with its own section of the rim, has a corresponding cylindrical projection upon it, which is turned in the lathe to fit the radial holes in the hub. The sections of the rim where they join each other are secured with the usual internal link and driven keys, riveted over on the outside to prevent withdrawal; and the turned ends of the arms are secured in the hub with similar riveted keys through slots, cast in them and the hub for that purpose. This is something of a novelty in the construction of large sectional fly wheels, and has at least the merits of cheapness, precision, and security.

A rather curious feature in this engine is that the connecting rods—as necessarily must be the case with the crank pins inserted in the wheel centers—pass outside of the fly wheels; the crossheads being of sufficient length to permit of the fly wheels revolving between them and the steam cylinder; and the shaft being below the cylinder, the connecting rods are long enough to keep the crosshead clear of the rims of the wheels at the top. The weight of the two pistons, piston rods, and crosshead is balanced by coring out some of the arms and a part of the rims of the wheels, which externally are symmetrical in form. The valve gear very much resembles the old Stevens cut-off with its side pipes, poppet valves, and overhung lifting rods: except that the long toes of that form of valve gear are replaced by friction rollers working in the lower ends of the lifting rods and actuated by peculiar cams upon a rotating shaft which receives its motion by the intervention of spur gearing from the engine shaft. This arrangement is called the Wanock cut-off, and, as an expansion gear, can only be adjusted by hand. This machine seems to be a well conceived design for blowing purposes under pressure, all the strain being received and transmitted in direct lines, except in the case of transverse strains upon the crosshead, which, if the work of the machine requires that the fly wheels should be as heavy as they are made, has the appearance of being entirely light to transmit the momentum of these rotating masses of iron.

The Japanese mechanics have finally entombed themselves in their new abiding place, for any one of them is now rarely to be seen outside of that structure. The clatter going on within, however, gives note that they have by means ceased their labors. They have expressed themselves as considerably astonished—which must, however, have been in the form of words or gestures, for their immobile visages seem incapable of any such expression—at the rapidity with which the "Melican man" erects his large and handsome buildings, and they rather feel themselves in the shade in this respect. At the beginning of their labors, a large and curious throng was always to be found observing and criticising the tools and methods of the "Japs," and no doubt gave the foreigners the impression that they were creating a grand excitement among, and imparting much valuable knowledge in the building line to, the American mechanics and architect. If such has ever been their state of mind on that subject, they have evidently become disabused of it; for not only have they expressed their surprise at the rapidity of our workmen, but they now look upon their own chosen instruments and tools as inferior to ours: as is instanced in the fact that Mr. Henry Disston, saw manufacturer of this city, has received an order from them for 900 hand saws to be sent to Japan. In the operation of such tools as planers and saws, their cutting is done by pulling the tools towards them; but they are evidently coming to the conclusion that a little American "push" is the best.

J. T. H.

Editorial Amenities.

Under the head of "New Industries Wanted," we lately published a paragraph relative to the needs of the people of the Mississippi Valley, which we quoted from and credited to the *Engineering News*, as it appeared in that paper without credit to any other journal, and, we supposed, was original with the *News*. We are now in receipt of a note from the editor of the Indianapolis *Journal of Commerce*, desiring us to inform our readers that the paragraph in question was original with him and first printed in his paper

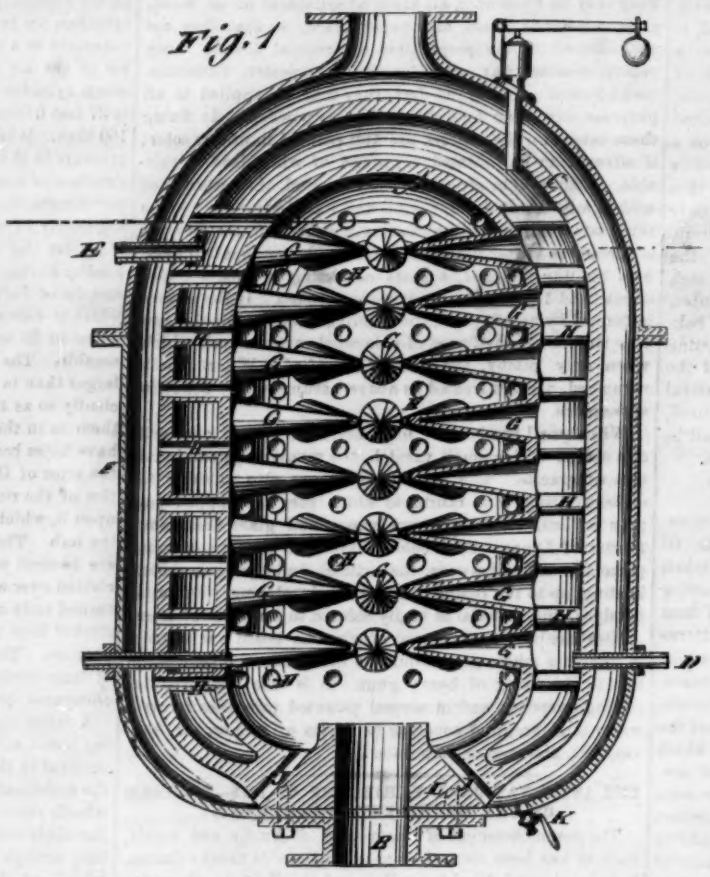
IMPROVED FEED WATER HEATER.

We illustrate herewith a new feed water heater, so constructed as to avoid risk of fracture by contraction or expansion, and also to afford an efficient application of heat without obstructing the escape of steam.

Fig. 1 is a sectional elevation, and Fig. 2 is a horizontal section. A is the inner cylinder into which the steam is discharged from the engine, by the pipe, B. C is the water cylinder, inclosing the cylinder, A, and having inlet and outlet pipes, D, E; and F is the steam jacket surrounding the water cylinder. The hollow conical studs, G, radiate from the shell of cylinder, A, to its center, or nearly so, and conduct the water into the steam space from cylinder, G, so as to distribute the application of the heat very efficiently. The small exit steam pipes radiating outwardly from said cylinder, A, make another efficient distribution. Both the hollow studs and the exit pipes are distributed uniformly, or as nearly so as is necessary for producing uniform effects throughout the heater, and the capacity of the pipes, H, is regulated to that of the exhaust pipe, B. This pipe is prolonged a little above the bottom of the cylinder, A, to make a kind of trap to prevent the water of condensation from flowing back in it, and passages, J, are made for it to flow into the steam jacket, F, from which it may be drawn from a cock, K. Cylinders, A and C, are cast in connection together at L, making a substantial base, to which the jacket, F, is also connected, so as to seat the heater on the top of the pipe, B, or any other suitable support. Conical studs are provided, instead of tubes connected at both ends, with express reference to the changes of temperature to which the heater will necessarily be subjected when in use.

Patented February 22, 1876, through the Scientific American Patent Agency, to Mr. Timothy W. Hayes, of Trenton, N. J.

Fig. 1



HAYES' FEED WATER HEATER.

Tin in Tuscany.

At a meeting of the Paris Society of Civil Engineers, a paper was read on a discovery, said to have been made in Tuscany, of a vein of bioxide of tin. The vein is reported to be situated about a mile and a quarter southwest of the town of Campiglia Marittima, in Tuscany, at a place called Cento Camerelle, upon the western side of the Fumacchio, a spur of the Monti Calvi, a chain celebrated for its mineral deposits. The Cento Camerelle (Hundred Chambers) consists of a series of excavations attributed to the Etruscans, and dug out horizontally in the side of the mountain. The concretions with which they were filled have been removed in the course of ironstone mining. The tin was stumbled upon some yards from the Cento Camerelle in following up a vein of brown hematite. The tin ore is very compact, of a yellowish gray color, and of granular fracture. Specimens yielded from 58 to 72 per cent.

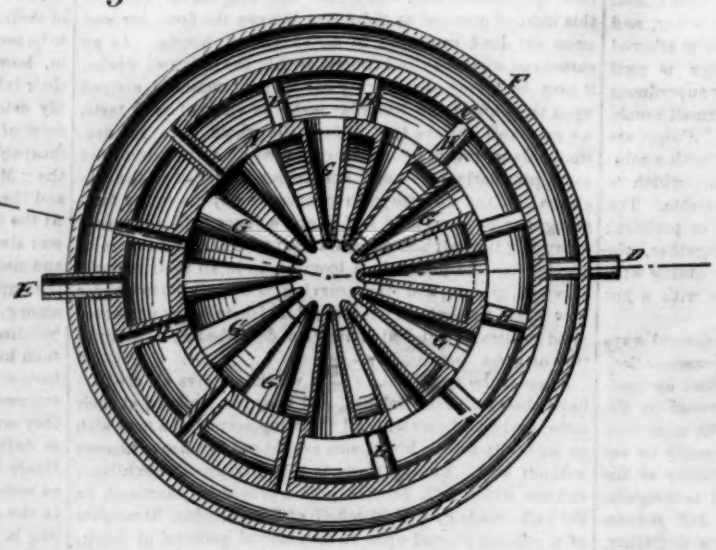
Fargier's Carbon Process.

According to the *Moniteur de la Photographie*, Fargier's new carbon process may be summed up in a few words. A sheet of paper is allowed to float upon a solution of five grains of chloride of iron and a similar amount of citric acid, which are dissolved in one hundred grains of water. This paper is afterwards dried in the dark, and placed under a negative to print, until a weak image is produced. This print is taken and floated upon a bath of colored gelatin solution, when it is found that the gelatin attaches itself to the portions of the surface that have been acted upon by light. There remains nothing but to wash the sheet in water, and the picture is finished. If, instead of a colored solution of gelatin in water, softened tissue were employed, the printed chloride of iron paper being pressed into contact with the same, warm water being used subsequently to separate the two surfaces again, there would perhaps be a step further gained in the simplification of the carbon process, for the pictures would be visible at once during the printing operation, and could therefore be controlled. Dr. Liesegang, writing in the *Archiv*, is of opinion that an improvement in the carbon process may be effected in this direction, and that the Fargier method indicates a branch of the subject which might be investigated with advantage.—*Photographic News.*

Pig Iron Pavement.

Twenty different kinds of paving have been tried in Paris; wood paving has been judged, gutta percha paving is too dear, in bitumen paving there is room for improvement, and now paving by pig iron is to be tried in a few days. A bed of mortar is first laid down, which is covered by a strong layer of asphalt; it is in this layer that the iron cakes, which are about 1·6 inches thick, are set. These cakes, it appears, preserve the homogeneity of the bitumen, and prevent its depression, and render the asphalt less slippery for horses. This pavement will cost more, assuredly, than the compressed asphalt, but it is estimated that this mode of paving will save 50 per cent upon the repairing expenses, which are very considerable. The end desired is to avoid, by the adoption of a kind of pavement, the depressions in roads over which a great deal of traffic passes. To attain this, it does not suffice to pour bitumen upon a well prepared ground lightly covered with a coat of lime; the resistance of the ground should equal that of an old macadamised bank; and a very thick bed of mortar, which should be very homogeneous, should be laid before the asphalt is laid.

Fig. 2



HAYES' FEED WATER HEATER.

Spectrum of the Electric Arc—A New Experiment.

In general, the electric light refers to the light coming from the incandescent carbon points, as well as from the space between them. Now, in this sense, the spectrum of the electric arc is a very common lecture experiment. But the words electric arc, in the strict sense of that term, belong to the arch of light between the points. This light is but slightly luminous, and is of a pale blue or violet color. Ordinarily, with a battery, the distance between the points is so small that the pure arc itself cannot be had separated from the points, and so its spectrum cannot be separately projected. But, during a recent lecture experiment by Professor G. F. Barker, at the Stevens Institute, with the arc of the Gramme machine, the experiment was successfully performed, the carbon lines being plainly produced on the screen. This, we believe, has never been done before as a distinct experiment; at any rate, we call to mind no record thereof. It should, however, be stated that, in the ordinary use of the spectrum of the electric light, the carbon lines occasionally flash out for an instant from a lateral discharge.

Man's Allotted Span.

The determination of threescore and ten years as the allotted period of human existence is doubtless in a considerable degree owing to that period having been adopted by the royal psalmist; but modern science, while it has postponed somewhat the average termination, has also still more largely prolonged the hypothetical duration of life. Flourens, reasoning from the time required for the full physical development of a human being, as compared with that taken by other animals, fixes the natural limit at 100 years, and this is also the period fixed by Dr. Farr as man's natural death time, although at present he finds, as the result of ten years' approximately accurate and complete registration, that this limit is scarcely reached by one English child in a hundred thousand. In some districts, of which the town of Liverpool is an exceptional example the proportion is much below this. In this, however, as in many other respects, we are far in advance of our ancestors. The early English poets fix the appearance of the signs of approaching senility much earlier than we are now accustomed to notice them, and Dr. Farr shows that, while two hundred years ago the mortality of London was about 8 per cent, and one hundred years afterwards 5 per cent, it is now only 2·4 per cent. And there is good reason to believe, says *Iron*, that it may be still further reduced—very much of the existing mortality depending upon the preventible causes, such as impure air and impure water, negligence on railways, on shipboard, in mines, in street police, and in many other ways. What is also of equal importance is the fact that any decrease in the mortality from these causes will be necessarily accompanied by the absence of disease, and an increase to survivors of that good health without which length of days is scarcely a boon. The economical results will be no less important. Disability from sickness is a source of pecuniary loss not only to the sufferer but to the entire community; while the longer old age, that one incurably malady, can be staved off, so much will be gained, for when the season of effective work is over, the individual, in ceasing to contribute to the general wealth, becomes a pensioner upon it. Thus, according to Dr. Farr, the Norfolk agricultural laborer, worth $25 at his birth and reaching at the age of twenty-five years his maximum value of $1,230, sinks at eighty to $205.

The Time to Plant.

It is useless to put seeds in the ground, *The American Garden* sensibly says, before the soil becomes warm and dry. For this reason no particular time can be specified for planting—everything depends upon the location, soil, and temperature. A very good guide is the taking up of a handful of the loam and closing the fingers tightly upon it. If, on opening the hand, the soil remains in a hard lump, and retains the imprint of the fingers, it is too wet; while if it falls apart in an irregular heap, it may be deemed in a condition for the seeds. Another reminder, and one that will prove a guide in all latitudes, is the forest tree. When trees put forth their young leaves, all nature is ready for active work. Seeds planted then germinate at once, and seldom fail to come up and grow vigorously. Nothing is gained by very early planting. Better be a grain too late than too early.

Save your Soapsuds.

Who would throw away a barrel full of soft soap or a box of hard soap? Were it not otherwise useful, it would be of great value as a fertilizer, if spread, in its raw state, about our fruit trees or berry bushes. But, after being dissolved in water and passing through the wash tub, gleaning the imperceptible elements of the best manure from soiled linen, its fertilizing power is vastly increased. Indeed we may almost say that the average soapsuds from the kitchen and laundry is worth more than the soap which produces it. Do not, then, allow your soapsuds to run away wasted, while you have trees which it might benefit.

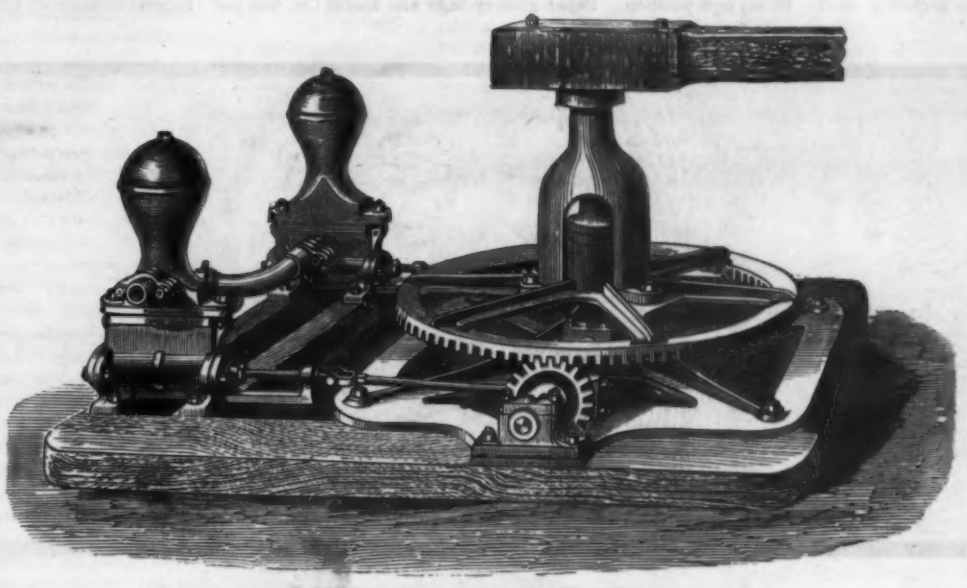
A Good Lacquer.

A preserving lacquer for brass or bronze, which gives a beautiful gilding to the articles, is also mentioned in the same paper. It is prepared simply by dissolving in 832 parts of rectified spirit 16 parts of shellac, 4 parts of dragon's blood, and 1 part turmeric root. The metal to be lacquered is warmed, and the varnish applied means of a sponge. Brasswork becomes beautifully gilded by this application. As the liquid is a spirit solution, it is necessary, of course, to keep it in a well stoppered bottle.—*Photographic News.*

HORSE POWER PUMP.

We are constantly receiving inquiries, from farmers and others, as to the easiest and most economical way of bringing water from a moderately distant point into a dwelling or barn. Probably the cheapest plan and one of the most efficacious is to use a windmill to actuate a suitable pump, and some of our correspondents have availed themselves of this means; others, however, have found local objections to the windmill, and, possessing horses, have asked us for a method of devoting the power of their animals to the purpose of raising water.

One of the simplest and most compact machines designed to meet this requirement is illustrated in the annexed engraving. The beam to which the horse is harnessed turns by its vertical shaft an inverted crown wheel, which actuates two smaller pinions, the rotary motion of which, changed by simple means into reciprocating, works the pistons of the two pumps. This apparatus is an English invention, and is manufactured by Messrs. Hayward, Tyler & Co., of London. It is light and portable and easily constructed, while it is capable of raising a large body of water. Such an apparatus would be useful on any large farm for supplying stock with water, or for irrigating purposes. Any of our manufacturers of pumps and horse powers may get an idea from this illustration which they can modify to suit special requirements, by omitting one of the pumps or by substituting some other kind of pump, or by changing the mode of gearing. It would seem as if there would be a good demand for something of the kind which is compact, simple, and not too costly.



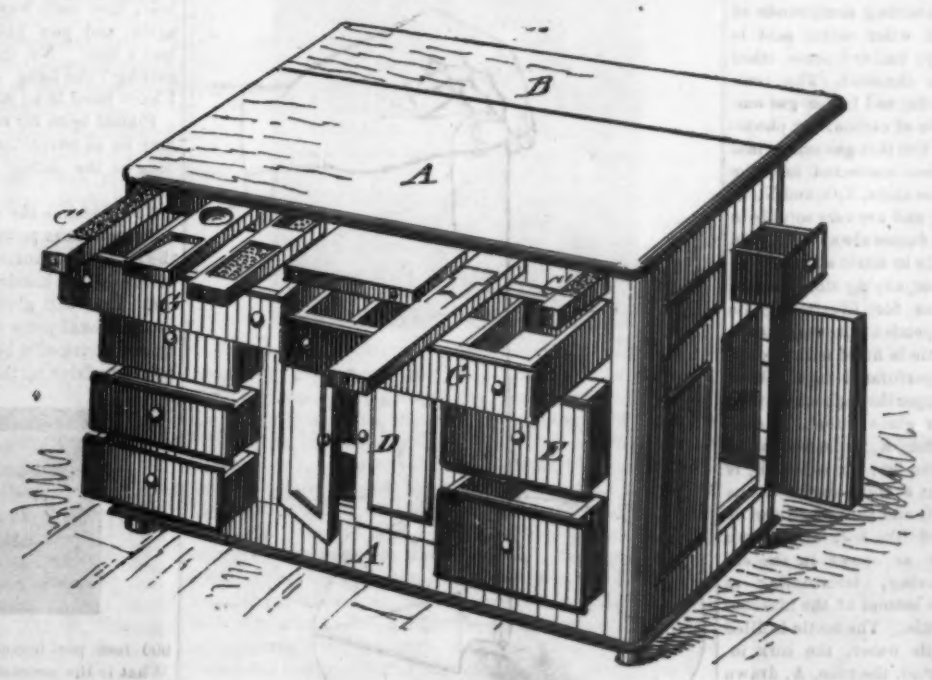
HAYWARD & CO.'S HORSE POWER PUMP.

IMPROVED KITCHEN FURNITURE.

Mr. George Holt, of Minneapolis, Minn., has recently invented an article of kitchen furniture which shows considerable ingenuity in economizing space, and contains places for nearly all the articles required for use in culinary operations, the utensils, etc., all being arranged so as to be ready at hand.

A represents the top or table; B is a hinged leaf at the rear side, supported on suitable slide pieces; and C is an ironing board that is placed in front corner slides, C', which are also made use of for sharpening knives. The central front part of the cabinet is arranged for shelves, D, forming a dish cupboard with hinged doors. At both sides of the shelves, D, are drawers, E, for miscellaneous articles—flour, sugar, meal, towels, etc.; and above the shelves, D, and drawers, E, are two drawers, G, of smaller hight, but with inside partitions, one drawer being for forks, knives, and spoons, the other for spices, etc. Below the top, and between the slides, C', are arranged various sliding devices, as a bread board, a vegetable cutter, a knife scourer, a grater, and others, which are drawn out as required, being pushed in after use. The space at the rear part of the cabinet is divided by a central partition into longitudinal chambers, F, for storing various larger articles of kitchen use, as tinware, potato mashers, etc., while longitudinal drawers, F', occupy the remaining available space.

Patented October 5, 1875. For further particulars address the inventor as above.



HOLT'S KITCHEN CABINET.

Progress of the Sewing Machine in Europe.

At the annual soirée of the employees connected with the extensive works of the Howe Sewing Machine Company, Glasgow, Scotland, recently held, the chairman stated that the British islands alone had taken a third of the machines (61,123) which the company had made in 1875. The little kingdom of Belgium, with her 5,000,000 of industrious people, took twice as many machines in proportion to population as Great Britain; but France, with her 36,000,000 of people, as yet took but half as many as Great Britain, with 33,000,000. Germany, with her 40,000,000 did no better. Italy and Spain, the former with 26 000,000 and the latter with 17,000 000, as yet purchased but a few hundred machines per year. Entire Scandinavia was an explored region; while Russia, with her 85,000,000 of active and rapidly progressive people, as yet received but the tenth part of what were now sold in Great Britain.

A little strong soap lather mixed with the starch will prevent flat irons sticking to linen.

Useful Recipes for the Shop, the Household, and the Farm.

To give black walnut a fine polish so as to resemble rich old wood, apply a coat of shellac varnish, and then rub it with a piece of smooth pumicestone until dry. Another coat may be given, and the rubbing repeated. After this, a coat of polish, made of linseed oil, beeswax, and turpentine, may be well rubbed in with a dauber, made of a piece of sponge tightly wrapped in a piece of fine flannel several times folded, and moistened with the polish. If the work is not fine enough, it may be smoothed with the finest sand paper and the rubbing repeated. In the course of time the walnut becomes very dark and rich in color, and in every way is superior to that which has been varnished.

To separate honey from wax, put honeycomb and all in a tin pan upon a moderately warm stove, adding a tablespoonful of water to each pound of honey. Stir occasionally with a piece of wire until the contents of the pan are in a liquid condition. Do not allow boiling to begin. Remove the pan from the fire and set it aside to cool. The cake of wax, to which all impurities will adhere, may then be carefully lifted off with a knife.

A good durable whitewash is made as follows: Take half a bushel of freshly burnt lime, slake it with boiling water; cover it during the process, to keep in the steam. Strain the liquid through a fine sieve, and add to it 7 lbs. of salt previously well dissolved in warm water; 3 lbs. of ground rice boiled to a thin paste and stirred in boiling hot; ½ lb. of powered Spanish whiting; 1 lb. of clean glue, which has been previously dissolved by soaking it well, and then hanging it over a slow fire in a small kettle, within a large one filled with water. Add 5 gallons of hot water to the mixture, stir it well, and let it stand a few days covered from dirt. It must be put on quite hot. For this purpose it can be kept in a kettle on a portable furnace. About a pint of this mixture will cover a square yard.

A process of tinning iron tacks is to triturate chloride of zinc with a large quantity of oil and heat it in an oscillating vessel. As soon as this has reached the proper temperature, throw in the tacks and the necessary quantity of metallic tin, and after a few seconds dip them out with wire gauze and cast them in water.

The removal of sand, etc., adhering from the molds to iron castings, generally accomplished by filing, is said to be effected far better by means of steel brushes. They are made of thin strips of steel, in the form of ordinary scrubbers, and also in that of whitewash brushes, and are reported to remain sharp for a long time, and to be far more convenient in use than the file.

Bronze powders: Bright yellow, copper 83 parts, zinc 17; orange, copper 90 to 95, zinc 5 to 10; copper red, copper 97 to 99, zinc 1 to 3.

A correspondent of the *Country Gentleman* reports excellent results for the following recipe for staining wood: 1. Wash the wood with a solution of sulphuric acid and water, made in the proportion of 1 oz. to a pint of warm water. Mix when wanted; put on warm and wash evenly over every part. 2. Stain the wood thus prepared with tobacco stain, using a piece of flannel or sponge, rubbing it in lightly. To make the stain, take 6 lbs. common shag tobacco, cover with water and boil, letting it simmer slowly away till of the consistence of sirup. Strain for use. 3. When entirely dry, brush it over with the following mixture: ¼ lb. beeswax, ¼ pint linseed oil, 1 pint boiled linseed oil. This may be omitted, and the wood simply varnished and polished instead. When it is desired to give the tone of light oak or maple, the solution of sulphuric acid should be much weaker, and only a light coat of the stain used. When a dark tone is preferred, two coats of the stain should be put on.

Linseed oil has been sold for pharmaceutical use mixed very largely with cod oil. The adulteration is detected by mixing 1½ ozs. of the oil with 0·4 oz. of nitric acid, and agitating. The liquid is then put by till the acid and oil separate; and if the oil has a darker brown color and the acid turns yellow, proof of adulteration with cod oil is manifest.

The following is a method of giving cast iron the appearance of bronze without coating it with any metal or alloy. The article to be so treated is first cleaned, and then coated with a uniform film of some vegetable oil this done, it is exposed in a furnace to the action of a high temperature, which, however, must not be strong enough to carbonize the oil. In this way the cast iron absorbs oxygen at the moment the oil is decomposed, and there is formed at the surface a thin coat of brown oxide, which adheres very strongly to the metal, and will admit of a high polish, giving it quite the appearance of fine bronze.

If wool be dyed black according to the following recipe, the dye, it is said, does not rub off, the fibers remain loose, and the wool has a desirable reddish cast: Boil the thoroughly washed wool well for an hour and a half in a bath composed, for 100 lbs. of wool, of 2½ lbs. of chromate of potash, 2½ lbs. of alum, ½ lb. of blue vitriol, and 2 lbs. of commercial sulphuric acid, and dye it, without rinsing, in fresh water, with 20 lbs. of logwood and 20 lbs. of Brazil wood. It is advantageous for the color to allow the wool to remain in the mordant for 12 hours.

Professor Charles A. Seely has invented a new mode of filtration. At the bottom of an open glass tube, say 1 inch in diameter, he places a piece of felting paper, and over this a piece of India muslin, which is secured around the tube by a rubber ring. The tube is filled with the liquid to be filtered, and is closed at the top with a rubber stopper, through which runs a piece of rubber piping. The tube is connected with the two bottles, so arranged that the water in the upper one flows down into the lower one, forcing out the air, which in turn runs through the rubber pipe, forcing out the liquid through the filtering material.

Washing the face night and morning in ½ pint of water to which the juice of 1 lemon has been added is said to be a good remedy for freckles.

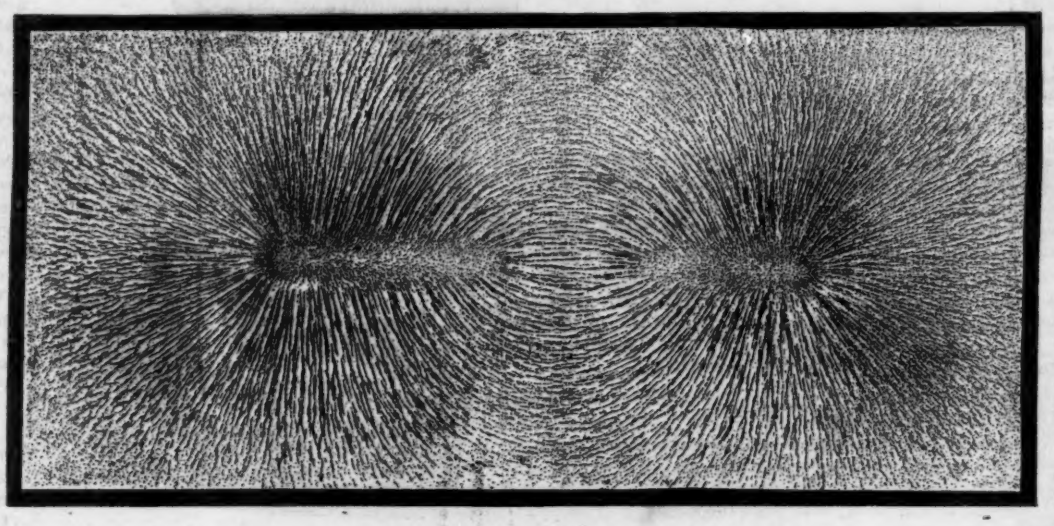
The secret of raising fine quinces, according to a correspondent of *Inter-Ocean*, is to purchase the orange variety, and set the trees from six to eight feet apart in rich soil. Bandage the stem with two or three wrappings of old cloth as far down in the ground as possible, as the roots start from near the surface. Let the bandages run six or eight inches above the ground, then pack the soil a couple of inches around the bandages. This should be renewed every spring.

Waterproof glue may be made by boiling 1 lb. of common glue in 2 quarts of skimmed milk. This withstands the action of the weather.

THE MAGNETIC SPECTRUM.

In a lecture delivered by Professor Barker at the Stevens Institute of Technology, and described in the SCIENTIFIC AMERICAN of March 18, one of the most striking experiments was the exhibition of the magnetic spectrum upon the screen. The name magnetic spectrum has been given by physicists to the arrangement which iron filings assume under the influence of the poles of a magnet; and these spectra afford a convenient means of studying the lines of magnetic force. Professor Mayer's method of rendering magnetic spectra permanent will enable any one to obtain plates like that from which the engraving herewith has been made.

Having dissolved shellac in strong alcohol, it is allowed to stand for a week or more until it is perfectly clear. It is then decanted and flowed over a thin glass plate, just as photographic plates are coated with collodion. After carefully drying for a day or two in a place free from dust, "the plate is placed over the magnet or magnets, with its ends resting on slips of wood, so that the under surface of the plate just touches the magnet. Fine iron filings, produced by drawfiling Norway iron which has been repeatedly annealed, are now sifted uniformly over the film of lac by means of a fine sieve. The spectrum is then produced by vibrating the plate by letting fall vertically upon it, at different points, a light piece of copper wire. The plate is now cautiously lifted vertically off the magnet, and placed on the end of a cylinder of pasteboard, which serves as a support in bringing it quite close to the under surface of a cast iron plate (1 foot diameter and ¼ inch thick), which has been heated over a large Bunsen flame. Thus the shellac is uniformly heated; and the iron filings, absorbing the radiation, sink into the softened film and are fixed."



THE MAGNETIC SPECTRUM.

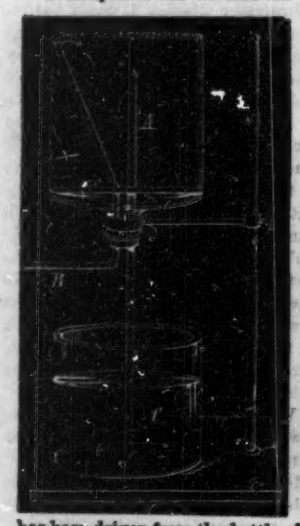
When the plate is to be used for photographic prints, the heat is kept up until the metallic luster of the filings disappears by their complete immersion in the shellac. The photographic prints will exhibit the lines of force in white upon a black ground. When the plates are used for exhibiting them upon the screen, the lines of force will appear black. When prepared with great care, such plates may be used for the most accurate measurements of the magnetic field.

The engraving herewith was made directly from a plate prepared by Professor Mayer. C. F. K.

A NEW LECTURE EXPERIMENT.

One of the most curious and interesting compounds of nitrogen and oxygen is that formed when nitric acid is poured upon copper, silver, mercury, tin, and some other metals, as well as when heated with charcoal. The compound (N_2O_2) is known as nitric oxide, and is the gas employed, in connection with bisulphide of carbon, for photogenic purposes in Sell's new lamp. When this gas comes into contact with free oxygen, it is at once converted into the higher oxides—nitrous and hyponitrous acids, N_2O_3 and N_2O_4. The latter compounds are red vapors, and are very soluble in water. These are the poisonous red fumes always observed on dissolving sugar, starch, or metals in nitric acid.

G. Bruylants has devised the accompanying simple apparatus for illustrating its properties. A very large bottle is fitted with a doubly perforated india rubber stopper through which pass two glass tubes, one of which, A, is drawn out to a fine jet; the other, B, is bent at right angles at one end, and the other end is bent like a J, and drawn out as shown in the engraving, terminating at the bottom of the inverted bottle. The bottle is filled with water, the cork inserted, the tube, A, drawn out so as to project but a little distance above the stopper, and the bottle inverted. Nitric oxide is allowed to enter through B, until nearly all the water has been driven from the bottle. The tube, A, is then pushed in until about four inches from the bottom, as seen in the illustration, and the other end inserted in a vessel of water, C. Oxygen gas is now passed in through B, the aperture at once fills with red fumes, which dissolve in the small quantity of water still in the bottle, producing a species of vacuum. The water then ascends through A, producing a small fountain. If, in admitting the oxygen, excess is carefully avoided, the bottle may be completely filled with water.



The experiment is more instructive if the water be first made blue with litmus; the acid in the vessel then changes it into a fine red.—*Berichte der Deutschen Chemischen Gesellschaft.*

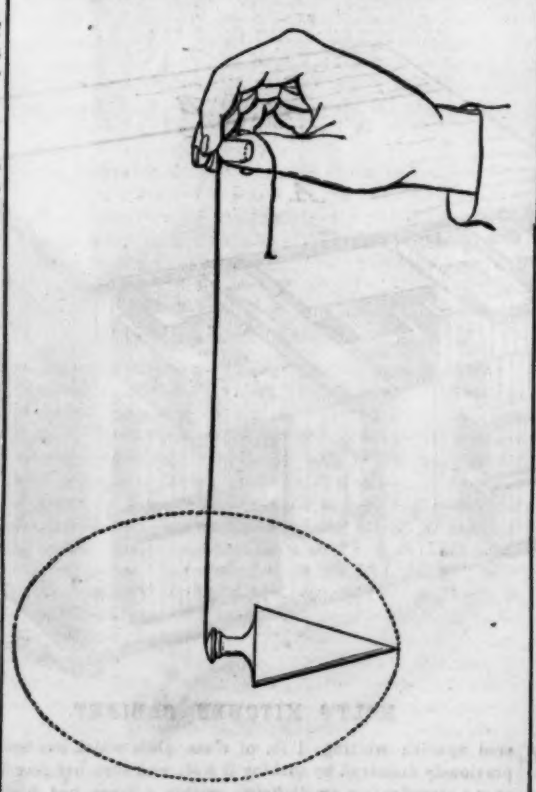
How to Set Out Roses.

Messrs. Dingee & Conard, the great rose raisers, give the following directions for the treatment of their favorite flowers: Make a hole so large that the roots may be spread out nicely. Cover the roots with fine soil, rather deeper than they were grown, and pack down lightly with the hand. It is generally best, though not always necessary, to protect the plants for a few days from the sun and chilling winds, until they become somewhat accustomed to their new position. Paper grocery bags are useful for this purpose, turning the bag completely over the plant, and supporting this with one or more sticks, heaping on a little earth to keep it in place. If the ground is dry, water thoroughly, soaking the earth down to the roots of the plants. Do not water too often. Like persons, rose plants want water only when thirsty. Let them get thirsty before giving them a drink.

SIMPLE FORM OF THE GYROSCOPE.

BY JOHN. C. DEANE.

Take an ordinary plumb bob, with a smooth hole where the cord is attached; wind about three feet of smooth hard cord about the neck of the plumb bob. Hold the end of the cord firmly and let the plumb bob fall; as it descends, and the cord unwinds, it will spin rapidly on its axis like a top, but instead of pointing toward the floor the axis will take a horizontal position at right angles to the cord, as shown in the engraving; and while revolving rapidly on its axis, the



point will slowly describe a circle around the cord, as shown by the dotted line. This form of gyroscope may have been noticed before; but I have never seen it described, and accidentally discovered it only a few days ago.

Indianapolis, Ind.

MESSRS. Frahm and Scharnweber, of Chicago, Ill., request us to state that their spring power, described in our issue of March 11, can be constructed in large as well as small sizes, and that a machine of nearly 8 horse power is now being made.

Correspondence.

Something about Belting.

To the Editor of the Scientific American:

A first class leather belt will do 3½ times the service of the best rubber belt that is found in the market. There is no economy in using a rubber belt at any price, unless it be where there is great heat or dampness.

Leather belts should be thoroughly oiled before using. A good way to apply the oil, where there is much belting to be oiled, is to have the belting run off from one reel to another, through a pot of oil, with suitable rubbers to wipe off the superabundance of oil. Another very good method of applying the oil—and perhaps it would be preferable in a majority of cases—is to put it on with a paint brush. This should be done on both sides, with no sparing hand. A belt thus oiled will not require a second application under ten years, unless there be much dust to absorb the oil, and then it may be put on very sparingly compared with the first application. The advantages that an oiled belt has over a dry one are these: 1. It lasts longer. 2. It requires less power to drive the machinery. 3. It may be run much more slack, which makes the bearings less liable to heat, requiring less oil and less attention.

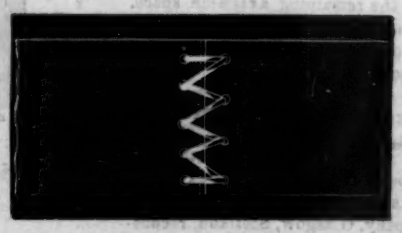
There are but few people who pay any attention as to how they put on a cross belt, consequently they are just as likely to get it on wrong as right. There are but two ways to put such belts on. The right way is this: Put the belt on in such a manner that the drive pulley will have a tendency to rough up the splices; then when the splices come to the crossing they will smooth each other down instead of catching under each other's corners and tearing open a splice.

A quarter twist belt should never be used where it can be avoided; but when it is used, it should be as narrow as practicable, and the pulleys should be large. Increasing the width of a quarter twist belt does not increase its power in the same ratio as in a straight or cross belt. There is not more than one per cent advantage in using an oiled belt with the grain side next to the pulley, which will hardly compensate for the ugly look which a belt presents when put on in that manner.

In lacing a belt, the lacing should never be crossed on either side. To lace a belt in this manner, there must be one more hole in one end than the other, consequently there will be a hole in the middle of one end, which is the place of beginning. Draw the lacing to its middle through this hole, lace each way to the edge and back to the middle again, and you have by far the nicest joint that can be put into a belt. No one will ever lace the old way after once getting "the hang" of this method. But it is old to me, as I have laced in no other way for twenty-five years.

Plaited belts for engine governors and small machinery may be as scientifically laced, and the fastening will last as long as the lacing of a flat belt, with no more unevenness.

To determine the width of a belt to drive all kinds of machinery, where power and speed are known. Rule: Place the number of horse power for a numerator, and the speed of the belt in hundreds of feet per minute for a denominator. That will give what the width of the belt should be in fractional parts of a foot. Example 1: What is the required width of a belt for a planer which requires six horse power to drive it, the verge of the driving pulley running at



900 feet per minute? Answer: $\frac{6}{8}=8$ inches. Example 2: What is the necessary width of a belt for an engine of 10 horse power, running at 100 strokes per minute, with a band wheel 3½ feet in diameter (11 feet in circumference)? Answer: $\frac{10}{11}=10\frac{10}{11}$ inches. E. H. DAVIES.

Santa Clara, Cal.

Human Remains in Michigan.

A party of scientists have begun the work of excavating and exploring the mounds at Spoonville, Mich., which were supposed to conceal the remains of prehistoric inhabitants of this region. Two mounds were opened. There were found human skulls, pottery, copper utensils, hatchets, needles, etc. It was the unanimous verdict that they were at least two thousand years old. Further explorations will be made. The scientists are of the opinion that this will prove among the richest discoveries of the kind on this continent.

HOW THE EARTH IS WEIGHED AND MEASURED.

LECTURE DELIVERED AT THE STEVENS INSTITUTE OF TECHNOLOGY, BY PROFESSOR C. A. YOUNG, OF DARTMOUTH COLLEGE.

It may seem paradoxical to state that the earth is the least accessible to us of all the heavenly bodies; but the fact is that we possess more accurate information concerning the surface of other bodies, such as the moon, for example, than we do of our own planet. There are six cardinal facts connected with the earth. 1. It hangs freely in space. 2. It is approximately spherical, having a diameter of about 7,912 miles; 3. It weighs about six sextillions of tuns, or would if the operation could be performed on its own surface, by bringing up one basketful after another to the surface and weighing it. 4. Its density is about 5·55 times that of water. 5. It rotates on its axis once a day. 6. It revolves about the sun once in a year.

The spherical form of the earth is proved by the shape of the shadow it casts upon the moon in an eclipse of the latter, and by the fact that we see the masts of a ship before the hull comes in sight. There are several other proofs, which it would take too long to describe; but the above are sufficient. The rotation of the earth is proved in various ways. If the earth did not rotate, a falling body would move in a straight line towards the center of the earth. In fact a body, however dropped, say from the top of a tower, will fall a little to the east of the vertical line. The reason is that the top of the tower moves faster than the bottom because it has a larger circle to describe in the same time, and the body dropped partakes of that motion. At a hight of 500 feet, this easterly deviation amounts to about an inch and a quarter. On the same principle a cannon ball will not preserve its true direction, but will be influenced by the rotation of the earth. The direction of the winds is also influenced in an important manner. Suppose a wind to start with a direction due north and south, and to keep that direction constantly. Then the earth's rotation from west to east will cause the wind to come more and more from the eastward, and it will change to northeast, east, southeast, south, southwest, west, and northwest. All this takes place without any real change in the direction of the wind; the change is only apparent, and because our position has changed. In this way the wind veers around in the direction of the hands of the clock about five or six times a year in the northern hemisphere. When there is any change it is due to a disturbance, and a storm is to be looked for. Storms usually rotate in the opposite direction. The lecturer proceeded to show how the rotation of the earth is demonstrated by means of Foucault's pendulum, which consists of a heavy globe of metal suspended by a wire in a frame, which may be rotated by means of a crank. When the pendulum is set in motion, it is found to swing in the same direction, no matter how much the frame is rotated. Now suppose such a pendulum to oscillate for several hours; it will constantly keep in the same plane, but the earth in the meantime carries the table under the pendulum around from west to east, and the pendulum will appear to have changed its plane in the opposite direction. This change is made apparent by means of a graduated circle on the table under the pendulum. In order to make accurate experiments, an extremely long wire and a heavy ball are used; and to insure a perfectly regular motion in one plane only, without any sideward swing, the ball of the pendulum is pulled back by means of a string, which is then fastened and burnt off. To keep it in motion for hours, an electro-magnetic apparatus is employed. At the pole the plane of oscillation would appear to move all around the circle, while at the equator it would continually coincide with the meridian, notwithstanding the rotation of the earth, and would appear unchanged. In latitudes between the equator and the poles, the apparent motion would be proportional to the sine of the latitude

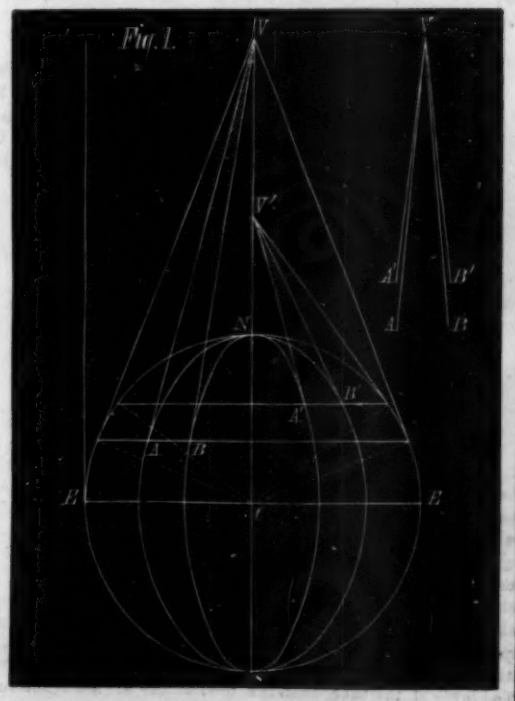


Fig. 1, a drawing by Professor MacCord, neatly illustrates he reason why the amount of deviation in the plane of oscillation of the pendulum diminishes as we pass from the pole to the equator. Suppose a pendulum to be set in motion at A, swinging in the direction of the meridian at that point, which direction is represented by the tangent, A V. It will tend to preserve this direction, when it is carried to B by the rotation of the earth; so that, instead of oscillating in the direction of the meridian at that point, represented by the tangent, B V, it will differ from it by the angle, AVB, included between the two tangents. Now, on taking a parallel of latitude nearer the pole, the angle, A′ V′ B′, formed by the tangents drawn to the two successive positions of a pendulum taken on the same meridians as before, will be greater; or in other words, the displacement of the plane of oscillation of the pendulum will be greater for the same amount of the earth's rotation on the parallel of A′ B′ than on A B. The angles, A V B and A′ B′ V′, which appear only as projections in the main figure, are shown in their true relation to the right. It will be noticed that the tangents drawn to the different meridians, at their intersections with the parallels of latitude, form the elements of a cone, the apex of which recedes further and further from the center as we approach the equator, and that therefore the angles between these elements become less and less. At the equator, all the tangents, as E I, being perpendicular, they would form a cylinder and not a cone; and as they are of course all parallel, the direction of the pendulum would not be changed in passing from one to the other. Another instrument for showing the rotation of the earth is the gyroscope, consisting of a well poised wheel, which continues to gyrate in one direction, but seems to describe a circle with its axis because the earth moves under it. The size of the earth has been pretty accurately determined. The following are the results obtained respectively by Bessel, Airy, and Clarke:

	Bessel.	Airy.	Clarke.
Polar radius in feet.....	20,853,668	20,853,810	20,853,429
Equatorial radius in feet	20,923,596	20,923,713	20,923,161
Ellipticity...	$\frac{1}{299 \cdot 15}$	$\frac{1}{299 \cdot 33}$	$\frac{1}{293 \cdot 93}$

According to Charles, the equator is also elliptical, and his measurements of it are as follows: Semi-major axis 20,926,350 feet (longitude 15° 34′ E.): semi-minor axis 20,919,972 feet (longitude 105° 34′ E.): difference 6,378. Equatorial ellipticity, $\frac{1}{3282}$.

Now in order to determine the dimensions of the earth so accurately, numerous arcs of meridians had to be measured. For this purpose two stations, say two hundred miles apart, are selected, and their latitude is first determined. This is the only part of the whole operation which properly belongs to astronomy. The latitude of a place is its distance from the equator reckoned on the meridian, or, which is equal to the same thing, the altitude or distance of the celestial pole above the horizon. This latter may be measured either by observing the same star at its highest and lowest points, or by observing the pole star, which describes a small circle about the celestial pole, and crosses the meridian twice in each revolution. These observations are made with the transit instrument and the zenith telescope. Having thus determined the true position of the two stations on the earth's surface, we proceed to the measurement of the distance between them. This is done by means of what is called triangulation. A piece of level ground, four or five miles long, is selected to get a base line, *c d*, Fig. 2, which is very accurately measured. Then a third station, *e*, is selected, and the angles it forms with the two ends of the base line are measured with a theodolite. Then, having one side and the angles, the other sides can be easily calculated. In the same way we compute the distance of the stations, *f* and *g*, and finally B. Usually hill tops are selected for the intermediate stations, and the observation of the angles is facilitated by the reflection of a beam of sunlight by means of a mirror, called a heliotrope, into the measurement. The observations are repeated many times to reduce the errors as much as possible; two feet in two hundred miles is about the limit of error allowed.

The measuring rods used in the United States Coast Survey are made of iron and brass in such proportion as to compensate for the elongation and contraction due to temperature. One is placed on tressles, and the other is carried forward and made to touch the first very accurately. The moment of contact is indicated by a spirit level connected with the rod by means of levers.

The length of a degree depends of course on the shape of the earth's surface, and the clock furnishes us with a ready means of determining that shape. The vibration of the pendulum is due to the attraction of gravitation, and this becomes greater as we approach the center of the earth. Hence a clock will go faster at the poles than at the equator. It will gain about four minutes, three of which are due to the centrifugal force as has been found by calculation, and one is due to the form of the earth. Therefore, in order to determine the form of the earth, or, in other words, the distance of the surface from the center at different points, all that is necessary is to carry the same pendulum to those points and observe the rate of variation. The best instrument for this purpose is Kater's pendulum, based on the principle (of Huyghens) that the point of suspension and the center of oscillation are interchangeable. It is adjusted by means of sliding weights until it keeps the same time, when it is suspended by its ordinary point of suspension, or turned upside down and suspended by its center of oscillation, which is also provided with a knife edge. This instrument is hung up in front of an astronomical clock beating seconds, and their rate of variation is ascertained by observing them through a telescope and noting the coincidences. It has been found that the degrees are about one seventh longer at the poles than at the equator. Although the accuracy of these measurements is often extolled, it not unfrequently happens that an error of two or three hundred feet is made in determining the latitude of places. Such errors are not the fault of the methods or of the observers, but are due to the variations of the direction of the plumb line caused by the attraction of mountains or dense rocks at the places in question. In the work of the United States Coast Survey, the average error is one hundred and twenty-five feet.

We are enabled to compute the weight of the earth by first determining its density; and this is done by comparing the attraction of the earth upon some object with the attraction of a body of known mass upon the same object.

Dr. Maskelyne accomplished this by determining how much a plumb line was deflected from its normal direction by Mount Schehallian, in Scotland. This deflection was found to be twelve seconds. If the mountain had been as dense as the interior of the earth, the deflection would have been twenty-one seconds. The mean density of the mountain was ascertained, by numerous borings and actual determinations, to be two and three fourths times that of water. Hence the density of the earth is 12 : 21 :: 2·75 = 4·81.

Cavendish, in 1798, compared the attraction of the earth with two lead balls, F and G, Fig. 3, each a foot in diameter. Two small lead balls, A and B, upon which the attraction was exerted, were attached to a wooden rod six feet long, suspended by a fine wire, D, E. When at rest, the position of the rod was observed by means of a telescope, T; then the large balls were brought near, on opposite sides, so that their attraction should conspire to twist the wire, and the change of position was observed by means of the telescope. The amount of force exerted in producing the torsion of the wire, D E, is the measure of the attraction of the balls. The attraction of the earth on the same balls is, of course, represented by their weight. Then, from the known density of lead and the law of gravitation that bodies attract each other directly as their masses and inversely as the squares of the distances, Cavendish computed the density of the earth to be 5·45 times that of water. More recent experiments with an improved form of the apparatus have proved that the density is 5·56.

Another method is by observing the rate of vibration of a pendulum at the top and bottom of a mine, or of a mountain. At the bottom of a mine a pendulum will be attracted only by the particles of matter below it, the stratum above it exerting no influence upon it whatever. More accurately speaking, a pendulum carried to a depth of 500 feet would

vibrate as though it were on the surface of a sphere having a radius 500 feet shorter than that of the earth. Since the density of the stratum above the pendulum can be found by experiment, we are enabled to deduce that of the earth by a simple calculation.

From the dimensions of the earth already given, its volume is found to be about 260,000,000,000 cubic miles, and its weight six sextillions of tons, which, when written out, will present the formidable appearance of 6,000,000,000,000,000,000,000 tuns.

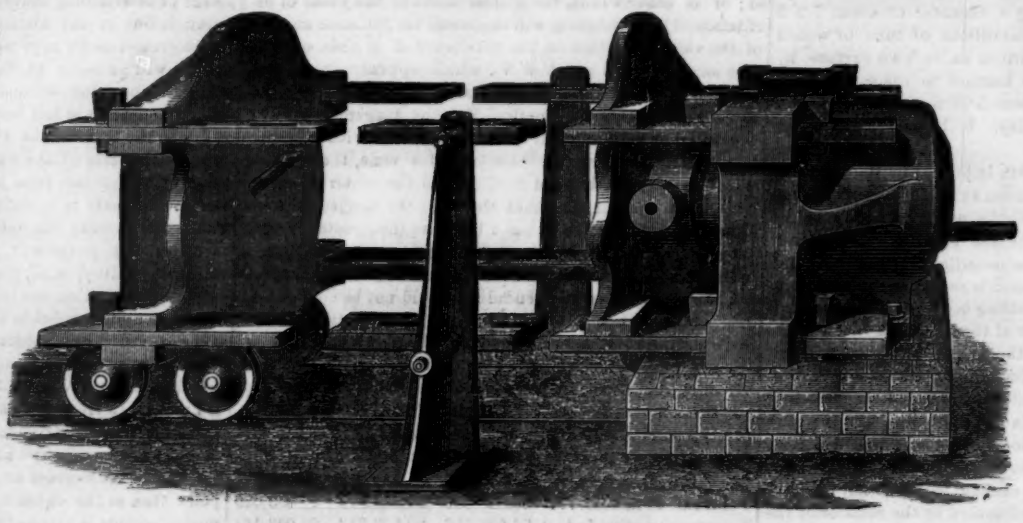
C. F. K.

TESTING BOILERS.

An English firm (Messrs. Howard & Co., of Old Hill, Worcestershire) is now making boiler shells with welded seams, a form of construction involving some difficulty in manufacture, the trouble of which will be amply repaid by the improvement in strength and durability of the boiler. Hydraulic pressure is used for testing the soundness of the welds, and for this purpose Messrs. Tangye Brothers, of Birmingham, have designed and constructed the machine herewith illustrated. It is capable of testing shells up to 4 feet in diameter and 35 feet long, at a pressure of 200 lbs. to the square inch.

The appliance, the engraving of which we select from *The Engineer*, consists of a fixed hydraulic cylinder, 12 inches in diameter and of 12 inches stroke, connected to a traveling head by rectangular wrought iron bars, 5 inches by 2½ inches, pierced with cotter holes of 11 inches pitch; the platen attached to the hydraulic ram slides along the bars. When a boiler shell is to be tested, the traveling head is run out of the way along the line of rails, and the shell is run in on a truck, the head is brought back to its place, and the cotters are inserted in the nearest cotter holes. Pressure is then applied to the cylinder by means of hydraulic pumps; the ram forces the platen against the end of the shell, and the joint is thus made tight, ready for testing. The shell is then filled with water from a tank by means of a flexible hose inserted into a passage in the platen, while the air escapes by the tube, marked B, in the traveling head; this tube is made to slide diagonally, so as to suit any sized shell. The tube is then closed by means of a cock, and the test pressure is applied by the hydraulic pumps.

The boiler seams are welded by means of a gas furnace placed over them; and special machinery has been made for planing the plates, bending them into the form of tubes, and facing the ends of the latter, as well as for testing them by the machine now under notice.



HOWARD & CO.'S BOILER TESTING MACHINE.

ATKINSON'S IMPROVED DESK.

Any person that has spent an hour or two bending over a sitting desk, steadily writing, knows what a wonderful relief is experienced when he can transfer his work to an upright standing desk and straighten the painful stitch out of his back. To afford this relief, and to add many conveniences not heretofore embraced in a single desk, are the objects of the invention illustrated herewith. This desk is readily changeable from a sitting to a standing desk, or *vice versâ*, by simply raising or lowering the table, which can be adjusted to any height; and besides, it can be placed at any angle desired. The movable table is pivoted to sliding pieces which travel in vertical guides on each side of the frame. Its weight is balanced by metal counterpoises which are secured by chains to the upper part of the slides, which chains pass over pulleys, so that the counterpoises hang inside the desk out of sight. The curved arms, A, which support the outer portion of the table, are also secured to the slide. These arms serve as guides for a third arm, B, which has projections on its inner end which engage in the rack teeth shown in Fig. 1, so as to aid in holding the table in whatever position it may be adjusted. The appearance of the desk with the table closed is shown in Fig. 2.

Fig. 1

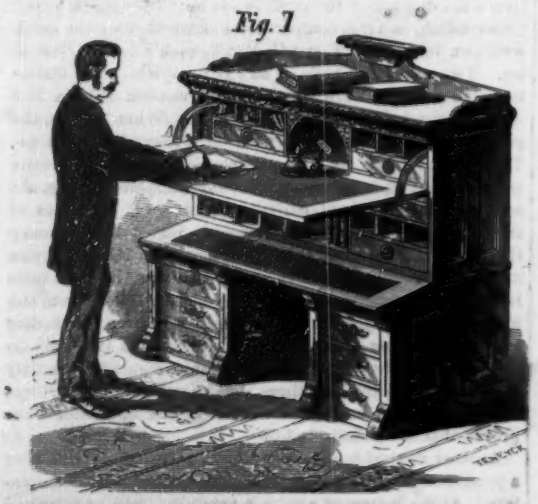
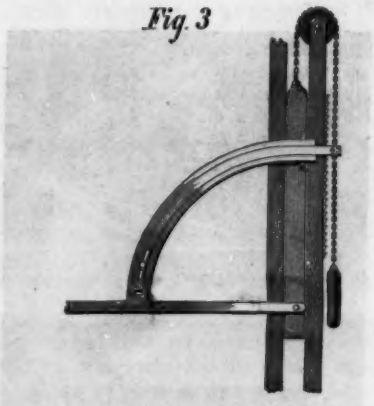


Fig. 2

The invention has a compact and ornamental shape, rendering it a handsome article of furniture for the library.

Patented through the Scientific American Patent Agency, March 7, 1876. For further information relative to rights to manufacture, etc., address Chas. A. Atkinson, 2 Clinton Place, New York city.

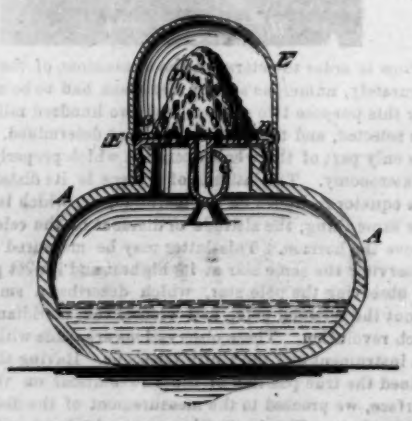
Fig. 3



IMPROVED MUCILAGE BOTTLE.

George R. Wight, of New York city, has recently invented a mucilage bottle, so constructed that the mucilage may be applied without a brush or any detached instrument. The bottle has a metallic cap, provided with an S tube and sponge.

A represents the bottle or cup; and upon the neck of the bottle, A, is formed a screw thread to receive the screw thread formed upon the inner surface of the flange of the metallic cap, B. In the center of the cap, B, is formed a hole, in which is secured the upper end of the small metallic tube, C.



The tube, C, is bent into an S shape, so as to prevent the air from entering the bottle, and to keep the mucilage close to the sponge. D is a sponge cut into a tapering or conical form, the base of which is secured to the cap, B, by sewing, small holes being formed through the cap for convenience in securing the sponge in place. E is a cap, made of such a size as to cover the sponge, D, without touching it, which fits snugly and airtight upon the outer surface of the cap. In using the device, the sponge should be kept moist with water to enable the mucilage to pass through it freely. To apply mucilage, the cap, B, is removed, the bottle is inverted, and the sponge, D, is rubbed over the place to which the mucilage is to be applied, care being taken to replace the cap, E, to prevent the sponge from becoming dry and stiff.

French Railway Signals.

The Paris correspondent of the London *Times* says: "The French Minister of Public Works has addressed a circular to the railway companies, calling their attention to an apparatus designed to prevent the terrible accidents resulting from the inefficiency of danger signals. The question is of immediate interest on account of the lamentable accident at Abbot's Ripton, and the ministerial circular deserves, therefore, the greatest publicity, I wished, before transmitting it, to obtain information personally as to the efficiency of the system patronized by M. Caillaux. The results communicated to the companies by the circular may be considered conclusive, and seem destined to make up for the inadequacy of optical signals, which are naturally thwarted by fog or by a sharp curve, an inconvenience which it has been attempted to remedy by fog signals. In England a mechanical contrivance has been devised putting in motion a rod which, being struck by the engine, produces a whistle; but the recent accident has proved that this device is not infallible. The system indorsed by the Minister of Public Works seems, on the other hand, to meet every objection. It can be placed at any distance, as it acts simply by laying down a wire The board which indicates danger, in moving, excites an electric current which leads to an apparatus placed in contact with the locomotive, and which produces a loud whistle. As soon as the indicator no longer indicates danger, the current is intercepted, and the locomotive may come in contact with the apparatus without causing a whistle. These experiments have been made during snow, and have invariably succeeded, the warning being given at a sufficient distance to allow of a train, running at full speed, being pulled up in time.

NEW FUSIBLE BOILER PLUG.

The annexed engravings, taken from the *English Mechanic*, represent a new fusible plug, which is intended to act as an efficient safeguard against boiler explosions. A bulb of gun metal, C, is provided with a screw shank, whereby it may be screwed into the top of the fire box. Through the bulb passes an inclined tapered tube, D, so that the outer surface of this tube and the inner surface of the bulb are subject to the heat of the fire, while the exterior of the bulb and interior of the tube are surrounded by the water in the boiler, which circulates through the latter The tube, D, is slotted, and the slots, E, are filled with soft metal, which, so long as the tube is full of water, is thereby kept from melting; but should the water in the boiler fall below the level of the tube, then the heat of the fire melts the fusible metal, forming apertures through which the steam rushes, thus relieving the boiler of pressure and at the same time putting out the fire. The device is the invention of Mr. T. J. Smith, of North Bow, England. Fig. 1 is a perspective view, and Fig. 2 is a vertical section

FIG 1.

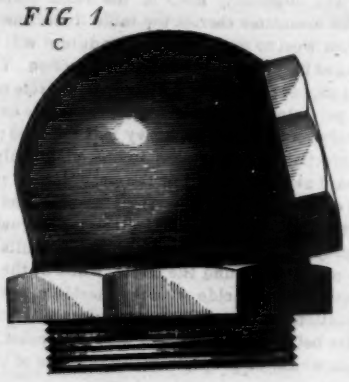
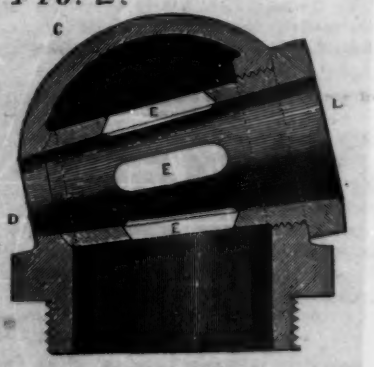
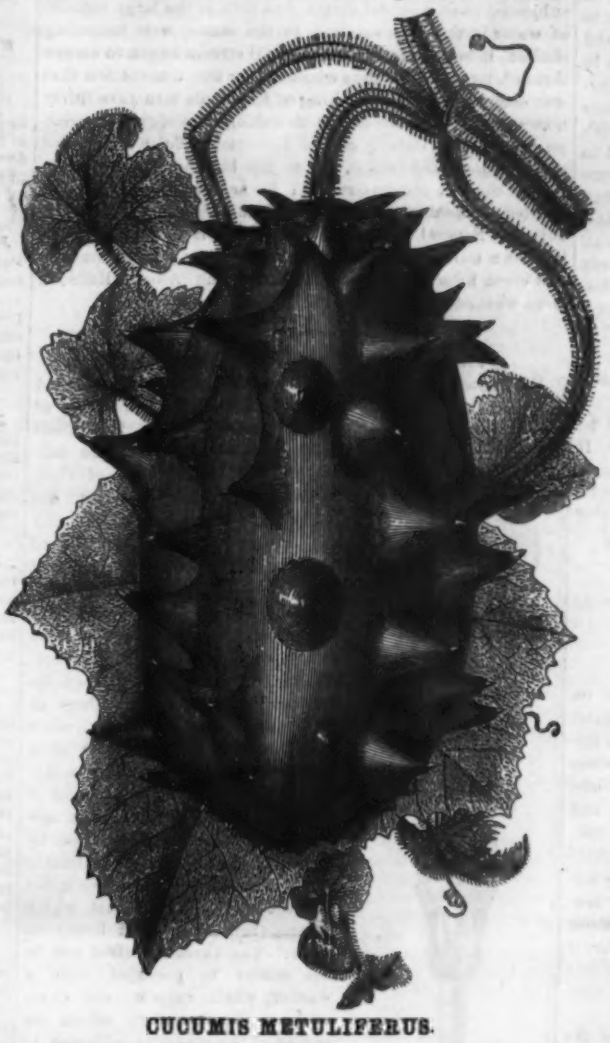


FIG. 2.



AN ORNAMENTAL GOURD.

We have already called attention to the beauty of many of the varieties of gourd, and their value in the flower garden as trellis plants. Their foliage is generally very handsome, and the fruit is frequently interesting on account of its eccentric appearance. Plants suitable for covering walls and arbors are by no means numerous; and the gourds are plants of large growth and rapid development, and are therefore worthy of cultivation. Nearly all members of the genus can be utilized for climbing purposes; and one of the best is the *cucumis metuliferus*, shown in our engraving. The venous structure of the leaf is highly organized, and the curious oblong fruit is studded all over with horny protuberances. The foliage is of a beautiful fresh green color; and if planted in a deep soil, in a sunny place sheltered from high winds, a very ornamental addition will be made to the garden. The gourds require plenty of water in dry weather, and liquid manure is highly beneficial to them.



CUCUMIS METULIFERUS.

The Early Discovery of Coal.

Bituminous coal, or sea coal, was known upwards of a thousand years ago, in the year 853, but did not come into general use until the 16th century, and was not used in the manufacture of iron until the 17th century. Anthracite coal came gradually into use so late as the 19th century, and was not used as fuel in the manufacture of iron until about 16 years ago.

So early as 1790 anthracite coal was known to abound in the county of Schuylkill, in the State of Pennsylvania; but it being of a different quality from that known as sea coal or bituminous coal, and being hard of ignition, it was deemed useless until the year 1795, when a Pennsylvania blacksmith, named Whetstone, brought it into notice. His success in burning it induced persons to dig for it; but when found, every person connected with the enterprise had to experiment on its combustion, and vain were the attempts to burn it by the majority of them, and all came to the conclusion that it would not come into general use.

About the year 1800, Mr. Morris, who had a large tract of land in Schuylkill county, Pennsylvania, procured a quantity of coal therefrom, and took it to Philadelphia city, but he was unable with all his heroic exertions to bring it into notice, and abandoned all his plans. From that time until 1806 it was talked about as a humbug; when accidently a bed of coal was found in digging a tail race for a water wheel for a forge, which induced another blacksmith, David Berlin, to make a trial of it. His success was generally made known, which induced others to try to burn Pennsylvania coal.

Study and Business.

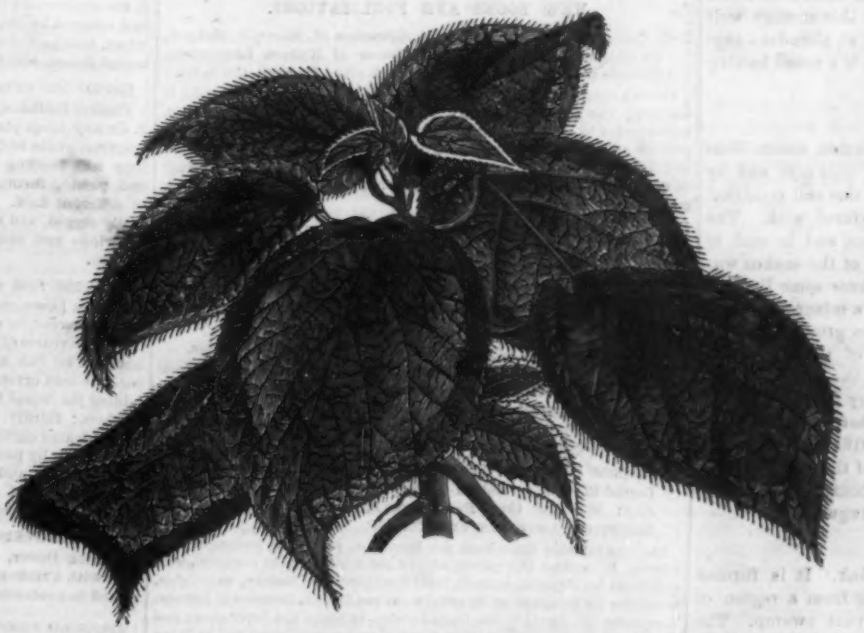
In learning, concentrate the energy of the mind principally on one study; the attention divided among several studies is weakened by the division; besides, it is not given to man to excel in many things. But while one study claims your main attention, make occasional excursions into the fields of literature and science, and collect materials for the improvement of your favorite pursuit.

The union of contemplative habits constructs the most useful and perfect character; contemplation gives relief to action; action gives relief to contemplation. A man unaccustomed to speculation is confined to a narrow routine of action; a man of mere speculation constructs visionary theories, which have no practical utility.

Excellence in a profession and success in business are to be obtained only by persevering industry. None who thinks himself above his vocation can succeed in it, for we cannot give our attention to what our self-importance despises. None can be eminent in his vocation who devotes his mental energy to a pursuit foreign to it, for success in what we love is failure in what we neglect.

ACALYPHA MARGINATA.

To the myriads of fine foliage plants which have been introduced of late years this is a welcome addition. The leaves, as regards size, resemble those of *acalypha tricolor*, but the markings, in which their chief beauty resides, are of a character wholly different from those of that variety. In the present case, the center of the leaf is brown, around which is a distinct margin of rosy carmine about a quarter of an inch in width; and the surface is entirely covered with little hairs, which add considerably to its beauty. This plant, says the English *Garden*, belongs to the spurgeworts, an order comprising upwards of a hundred species, which are more or less distributed over all tropical and subtropical regions, but the headquarters of which are in South America. A goodly number are annual, but the great mass are perennial plants, having much the appearance of nettles, and readily known from their nettle-like leaves and the disposition of their flowers.



ACALYPHA MARGINATA.

INCOMBUSTIBLE lamp wicks are made in Austria of asbestos

Railroad Crossings.

A bill has lately been passed by the Massachusetts legislature, providing that "no highway or townway shall hereafter be laid out across a railroad at a level therewith, nor shall any railroad be laid out and constructed across a highway or townway at a level therewith, without the consent in writing of the Board of Railroad Commissioners, in addition to the authority of the Court Commissioners, as now required."

This is an excellent and most sensible measure, and one which deserves the attention of the legislatures of all the other States. While we have scores of inventions for the safety of passengers in the cars, there is little attention paid to proper safeguards to keep people out of the way of the trains. As a rule, the railroad companies are only required to put up a sign to "look out for the locomotive when the bell rings" at road crossings, and blow whistles or sound bells when the train approaches the road, and that is all that is thought needful to protect the public from trains rushing at the rate of forty miles an hour. It is no easy matter to estimate the speed of an approaching locomotive, and accidents are constantly occurring simply through people thinking that they can drive across a track before the locomotive can reach the crossing, or on attempting to cross, and failing to observe the coming train until too late to avoid it. By sinking or raising the track, so as to leave a clear passage, these accidents, of course, become impossible. In England, it is of a very unfrequent occurrence for railway and highway to cross on the same plane; and whenever such intersection does exist, guards with signals are kept constantly on the alert.

The Thickest Armor Plate Ever Made.

Experiment was lately made at the great works of Charles Cammell & Co., Sheffield, Eng., which, it is believed, will have an important influence upon the future of ironclad navies. It was the rolling of the thickest armor plate which has ever been produced. Four and a half inches is the thickness of the plates with which vessels of the Warrior class are covered. Step by step the size has been increased till it has reached 14 inches, which, until the present experiment, was the thickest plate known. Messrs. Cammell & Co have now succeeded in producing one of 22 inches, this being eight inches thicker than any armor plate ever yet rolled. The plates, of which this is a sample, are intended for the Dandolo and Duilio, two war vessels now being built in Italy for the Italian government—one at their dockyard at Castellamare and the other at La Spezzia. These vessels are to be armored at the water line with plates of this thickness, and the representative plate now rolled was ordered for the purpose of ascertaining the relative resistance of plates of this enormous thickness compared with the thickest that has yet been manufactured. The gun to be used in testing this great plate is one of the 100 ton guns now being made by Sir William Armstrong & Co., at Newcastle. The vessels are to have two turrets, and each turret will contain two of these enormous pieces of artillery. The guns will be about 30 feet long, their bore 19 inches in diameter, and they will throw a shot weighing nearly one ton. Several hundred pounds' weight of powder are necessary for each charge. One of the guns is nearly ready, and Sir W. Armstrong has been specially asked to make a crane, capable of lifting 150 tuns, to move it. To give some idea of the enormous mass of metal of which the plate is formed, it may be stated that it had to be in the furnace upwards of twenty-seven hours before it was fit to be placed upon the rolls. It weighs upwards of 35 tuns, and measures 17 feet in length and 5 feet in width. The experiment of rolling such a monster was a bold one. Sir Joseph Whitworth, Sir W. Palliser, and a number of officials and diplomatists were present to witness the operation.

Before the plate was rolled, a luncheon was served at the works, at the conclusion of which a few toasts were given and responded to. Sir Joseph Whitworth's health was proposed in connection with his guns. In giving it, Mr. Cammell stated that if Sir Joseph's guns succeeded in penetrating the plate about to be rolled, he should have no hesitation in rolling one of 30 or even 40 inches in thickness. In reply, Sir Joseph Whitworth kept significant silence with regard to what he believed his guns would do when opposed to a 22 inch plate. Sir William Palliser's health was also given. In replying, he said, that, owing to the success of his projectiles, he at first thought that the days of iron-plated vessels were numbered, and that we should return to unplated ships with heavy guns. Subsequent experiments, however, satisfied him of the enormous resistance which armor plates presented to projectiles, unless they happened to strike exactly at right angles; and it was this enormous resistance that, in his opinion, rendered the retention of ironclad ships necessary to the country. Nobody could yet say whether the gun or the plate would win. If Sir Joseph Whitworth made a gun that would penetrate even a plate 22 inches thick, then a plate must be made that it could not penetrate; in fact, the bigger the guns, the more powerful must be the plates. Nobody could deprecate more than he the idea that, because of the increase in the power of penetration of our guns, iron-plated ships must be abandoned. What they required was that their plates should be more powerful. It was only in direct firing that the greatest penetration had been obtained, and it was but fair to presume that in actual warfare the greatest portion of the shots would be fired obliquely. He was quite aware that Sir Joseph Whitworth had invented a shot which would bite when fired from an oblique position; but even then the penetration was much inferior to that obtained by a direct shot. That being so, he was inclined to think that armor-plated ships would always possess an advantage over guns.

Shortly afterwards an adjournment was made to the armor plate mills. A group of men were standing round the furnace in which the plate was being heated, and at the word of command from a superior they began to pull away the bricks at the mouth of it. Instantly the flames leaped out, and the men, accustomed as they are to stand a great heat, were constrained to retreat until the fury of the flames had subsided. Then one wearing only trousers and a shirt approached the furnace, raised a little doorway, and looked at the huge monster within. The view was doubtless satisfactory, though how any one could look into this furnace unscorched was a marvel. Men were then seen guiding, up to the mouth of the furnace, a huge pair of tongs with which the plate was to be

grasped. A trolly, too, was sent almost up to the mouth of the furnace, and, by and by, it received the plate when the tongs had done their work. Everything was now ready. The doorway of the furnace was lifted up, the flames shot out and lit up the mill, and, while spectators shielded their faces with their hats or handkerchiefs, the workmen, with their backs to the furnace, pushed up the tongs until they grasped the plate within. Balks of wood were then put on each side of the furnace to enable the plate to be drawn out the more readily; but the flames seized upon them and appeared to devour them as if mere shavings. There was no time to lose, the order was given, and machinery began to move, the chain fastened to the tongs slowly tightened, and the huge mass, which had required twenty-seven hours in such a furnace as this before it was done, made its appearance. Fierce as had been the heat before, it was now ten times greater. One could hardly look upon the plate, white with heat, over and around which little blue flames appeared to be lingering. Slowly it fell upon the trolly, the tongs were then removed, and in a moment or two the rolls, which had been revolving for a while, caught the end of the plate; and the huge mass, weighing 35 tuns, passed between them with as much ease as if it were but a 4½ inch plate. Backwards and forwards it came six or seven times, each time the distance between the rolls being decreased, and the operation ended as soon as the required size had been attained. The rolling was most successful, and it is believed the plate is without a flaw. The destination of the plate is Spezzia, where the test is to be carried out.

The experiment shows that there is absolutely almost no limit to the thickness of which armor plate can be made. It was no idle boast on the part of Mr. Cammell when he said that, if Sir Joseph Whitworth's gun penetrated this plate, he would make one 30 inches or 40 inches thick. The result of the test at Spezzia will be watched with great interest — *Iron*.

SCIENTIFIC AND PRACTICAL INFORMATION.

STRANGE NATURAL CISTERNS.

In the rough granite country back from Mossamedes, on the west coast of Africa, are some very remarkable natural cisterns. The country itself is peculiar, huge single rocks rising out of the nearly level plain in some places, and in others hills of rock, in several of which deposits of water are found at the very top. A recent traveler visited one of these, and describes it as a natural tank with a narrow entrance, containing some three or four hundred gallons of exquisitely clear and cool water. It was covered by vast slabs of granite, from which the rain drained into it during the rainy season, shading the water so that it could not be seen without a torch, and so protecting it that the sun cannot evaporate it during the dry season. Thus a bountiful store of excellent water is preserved while there is not a drop to be had elsewhere for miles.

A still more remarkable cistern of this sort is that of the Pedra Grande, or Big Stone, some thirty miles from Mossamedes, a huge rounded mass of granite rising out of the sandy plain. On the smooth side of this rock, twenty or thirty feet above the plain, is a circular pit about ten feet deep and six feet across. The rainfall on the rock above the pit drains into it, filling it completely every rainy season. The walls of the pit—which is shaped like a crucible, narrowing gently to the bottom—are perfectly smooth and regular, the enclosing granite being of the closest and hardest description. The cistern will hold several thousands gallons of water. Near by are smaller pits of similar character. Their formation is unexplained. The water of this strange well furnishes the natives and travelers with an abundant supply during the dry season; consequently it is a noted halting place.

A SPITTING SNAKE.

There is a dangerous snake, not uncommon about Benjuella, West Africa, called by the natives *naja neje*, and by the Portuguese *cuspedira*. It is small in size and remarkable from its habit of spitting when interfered with. The saliva is ejected to considerable distances, and is said to cause blindness if it touches the eyes. One of the snakes was captured by the natives and brought to where some English miners were at work. It was teased by a miner who was standing over the cage, which was on the ground, and retaliated by a discharge of spittle. Some of the liquid entered one of the miner's eyes; and though the eye was immediately washed out with water, it was very much irritated for several days. The snake was killed before any experiments could be made with it by the scientific superintendent of the mine; he has, however, no doubt of the miner's statement and that of his companions, corroborated as it is by the testimony of the natives and the Portuguese.

A RIVER OF INK.

In Algeria there is a river of genuine ink. It is formed by the union of two streams, one coming from a region of ferruginous soil, the other draining a peat swamp. The water of the former is strongly impregnated with iron, that of the latter with gallic acid. When the two waters mingle the acid of the one unites with the iron of the other, forming a true ink. We are familiar with a stream called Black Brook in the northern part of this State, the inky color of whose water is evidently due to like conditions.

A. RICCO, of Modena, Italy, says: To cure the swellings of chilblains, rub them well at night with petroleum. It will take three or four nights rubbing to cure them.

The Breaking of the Lynde River Reservoir Dam.

A serious disaster, causing a large destruction of valuable mills and other property, occurred in the vicinity of Worcester, Mass., on the 30th of March, through the rupture of the dam of the Lynde river reservoir, whence the water supply of the above city is derived. The reservoir has a capacity of some 670,000,000 gallons, and by the recent heavy rains became filled to its utmost extent. The embankment wall, it is said, was known to be too low for safety, and engineers had recommended its enlargement. These warnings, however, passed unheeded; and consequently, when the dam was subjected to an unusual strain, due both to the large amount of water in the reservoir and to the waste weir becoming choked, it became leaky, and a small stream began to escape through its masonry, thus commencing the destruction that was completed by the breaking of the whole structure thirty hours later. As soon as the first dangerous sign appeared, people in the vicinity of the threatened flood abandoned their houses and shops, and so the loss of life, which attended the like disaster at Mill River a year or so ago, was averted. The damage done is estimated at several million dollars. Several houses, the Bottomly, Smith & Co. Mills, besides a number of smaller manufacturing establishments, and eight hundred feet of the Boston and Albany Railroad were washed away.

THE NATIONAL STEEL TUBE CLEANER.

We show in the accompanying illustration an improved apparatus for cleaning the flues of steam boilers. All intelligent users of steam appreciate the economy of keeping the flues of their boilers clean and free from deposits of unconsumed carbon and ash, which are non-conductors of heat and cause a marked difference in the working of a boiler.

The National Tube Cleaner is a plain, practical, durable tool, and has many points of advantage. Among these may be mentioned the absence of small steel springs or thin bands of metal, which, when thrust into a hot flue, lose their temper and elasticity. The scraping edges, supported on blades of Bessemer steel, are cut from saw plates, and are held in place by doubly riveted braces of malleable iron. The blades are dove-tailed into the malleable iron butt, which insures their being held firmly in place. The threaded steel rod in the center is provided with a washer, which runs up and down upon it, by means of which the spread of the blades is adjusted to the size of the flue. These implements received the silver medal at the American Institute in 1875, the first premium at the last Industrial Exhibition in Pittsburgh, and also at the Providence (R. I.) exhibition. It is manufactured by the National Steel Tube Cleaner Company, and has been introduced through the agency of the Chalmers Spence Company of New York. It is sold by the principal dealers in engineers' and mechanics' supplies throughout the country.

NEW BOOKS AND PUBLICATIONS.

THE FIRST GERMAN READER: a Modification of Marcel's Method. By Charles F. Kroeh, A. M., Professor of Modern Languages, Stevens Institute. 67 pp. New York city: D. Appleton & Co.

This is a concise and admirable instruction book, for English pupils, in German. The entertaining story of Cinderella is presented in German, accompanied by a literal linear translation, which exhibits at one view the peculiar arrangement of the language. Excellent directions, vocabularies, etc., are given, the author's object being to convey a practical knowledge of the subject without burdening the learner with the technicalities of grammar.

PORTRAITS OF CELEBRATED DOGS. Price $2, for Set of Eight Portraits. New York city: "Forest and Stream" Company, 17 Chatham street.

These are well executed wood engravings of celebrated pointers and setters, and they will undoubtedly have a large sale among the shooting fraternity.

THE PHILADELPHIA LEDGER. Philadelphia, Pa.: G. W. Childs.

The enterprising publisher of this old and respectable daily journal inaugurated, on March 27, the forty-first year of its publication, by increasing its size and improving its general appearance. Under the proprietorship and management of Mr. Childs, the *Ledger* has become one of the most profitable newspapers in the country.

REFERENCE BOOK FOR INVENTORS AND MECHANICS. 125 pages. Bound in cloth, gilt edges. Price, by mail, 25 cents. New York city: Munn & Co., Publishers SCIENTIFIC AMERICAN and SCIENTIFIC AMERICAN SUPPLEMENT.

This is a valuable little book for inventors, patentees, mechanics, and others. It contains the patent laws of the United States complete, with directions for obtaining patents, trade marks, caveats, designs, copyrights, and forms for transferring, by assignment and license, interests in patents. It contains the census of the United States, by States and Territories; and contains also engravings of 150 mechanical movements, which will be found convenient for all mechanics and inventors to have at hand for reference. A more valuable compilation of rare and useful information has never been condensed into so small a compass, or sold at so cheap a price.

EVERY MAN HIS OWN LAWYER. By John G. Wells. 612 pages. Price, by mail, $2 25. New York city: John G. Wells, 3 East 4th street.

Mr. Wells has just issued a new edition of his business form book, adapted for all classes of persons. It is a guide in all matters of law and trade, and is adapted for every State in the Union. To those who have occasion to draw conveyances, to frame wills, agreements, and powers of attorney, or to make assignments, this work will be found most convenient. It contains a synopsis of the laws of all the States relating to usury, the rights of married women to hold property, how to obtain pensions and letters patent, and other matters likely to arise in the life and experience of most persons.

THE ALDINE.—Parts 6 and 7 of the new issue of this beautiful art publication are just from the press; and they compare favorably with the five first numbers of this year's issue. Several finely executed wood engravings of American and foreign scenery and copies from celebrated paintings of our best modern artists, executed by our most distinguished designers and engravers, are features in these issues which render the publication of special interest to lovers of art. Published fortnightly by the Aldine Company, 18 and 20 Vesey Street, New York city, and supplied, to regular subscribers only, at 50 cents a number.

Recent American and Foreign Patents.

NEW CHEMICAL AND MISCELLANEOUS INVENTIONS.

IMPROVED TINNED BLANK.

John C. Milligan, South Orange, N. J.—This inventor forms a little extension lip at one part of the edge of a round plate or blank of tin plate, the object of which is to receive the beads of tin that flow to the lower edge, and there solidify on drawing the sheet out of the bath, so that they can be removed from the sheet by cutting off the lip without destroying the symmetry of the blank.

IMPROVED BALE TIE.

Jesse R. Horton, St. Louis, Mo., and Henry A. R. Horton, McKinney, Tex.—This is a simple device whereby the end of the band is held in close contact with the other end by means of a lug, so that the swelling of the bale can never affect the security of the fastening, since the flanges of said lug do not permit it to be pressed out of the slot. The lugs are so arranged that they do not catch in the cotton or wrapping of the bale, either in the act of locking or unlocking.

IMPROVED CORSET SPRING.

Joseph Day, New York city, assignor to himself and Nathan Hyman, same place.—This is a corset clasp composed of a broad stay, having fixed hooks upon it, in combination with an overlapping stay having eyes hinged to fastening bands which pass around the stay, said eye being made with broad base, to allow the easy connecting and separating of the parts.

IMPROVED MICA LIGHT FOR STOVES.

John W. Elliot, Toronto, Canada.—This invention consists in a mica light, provided with a handle at the upper end, a perforation, and a strengthening tip, the same being applied to a window frame having a lip. The plate is sprung into the rim and guard lip of the stove body, and is provided with an eyelet at the lower part to admit the entrance of air.

IMPROVED FILTERING APPARATUS.

Leo Prange, South Brooklyn, N. Y.—In this filter, the liquid is passed through a body of charcoal and a series of bags, formed of woven fabric and suspended vertically from short tubes attached to the bottom of a tank. In order to hold the charcoal necessarily employed as a filtering medium, a strainer supported on a circular flange forms a false bottom to the vessel. The liquor filters through the charcoal and enters the space between the bottoms, whence it escapes as fast as it can ooze through the bags. In order to indicate the hight of liquor a glass tube is attached to the outer side; and in order that the tube may not become choked, the lower end is made to communicate with the space between the false and true bottom, so that only clear or filtered liquor can enter.

IMPROVED LOCK FOR POCKET BOOKS.

Daniel M. Read, New York city.—The device is fastened by pushing a catch into one of the holes in the case of the lock, when the inclined end of the said catch strikes against the rounded forward edge of a latch bar, pushes it back, and passes it. To unfasten the lock, the rear edge of the catch plate is slightly raised, which throws the engaging end of the catch back a little, so that its upper incline may readily slip off the rounded edge of the latch bar. With this construction there is no projection upon the outside of the lock to wear the pocket.

IMPROVED METALLIC SEAL.

Alphonse Friedrick, Brooklyn, N. Y.—This invention relates to certain improvements in that class of metallic seals in which a section of wire is employed for forming the loop, the ends of which wire are bent and secured in a soft metal button by compression. It consists in the construction of the soft metal button, which is made with a deep circumferential groove around its edges forming two connected disks, with or without a hole through the central smaller portion or stem connecting the disks. Around this button, in the groove and through the hole, the wire is variously twisted and secured by the compression of the soft metal button which, when stamped, forms the two edges of the disks into a single milled flange, which imparts greater security to the seal.

IMPROVED GUIDE AND REEL BAND FOR FISHING RODS.

Francis Endicott, New York city, assignor to himself and Henry F. Crosby, same place.—This consists of open (expanding and contracting) guide and reel bands for fishing rods, constructed with a loop and binding screws on one end, and a tongue on the other end, passing through the loop for being readily fastened on rods of different sizes. In case a rod is broken, a temporary rod can be easily rigged, and the carrying of a rod may be avoided by taking the rings and reel along and procuring the rod when wanted for use.

PROCESS FOR SEPARATING MIXED COAL TAR PRODUCTS.

Charles Lowe and John Gill, Manchester, England.—The nature of this invention is, first, to submit the partially or wholly dydrated mixtures of tar acids to the prolonged action of temperatures between 15° Fah. and 56° Fah.; secondly, to separate the hydrated carbolic acid crystals, thus formed, from the mother liquors containing the liquid tar acids and a residue of carbolic acid dissolved in them; thirdly, to effect complete purification of the more or less hydrated carbolic acid crystals thus obtained by recrystalization, either by partial fusion or solution in water with subsequent refrigeration; and lastly, to prepare carbolic acid of high or complete degrees of purity by dehydrating the partially or wholly purified more or less hydrated carbolic acid crystals.

IMPROVED COMBINED WATCH CHARM AND KEY.

Patrick Dever, Glen Riddle, Penn.—This consists of a suitable case with a sliding and a spring-acted key, that is retained or released to protrude from the case by suitable catch device.

IMPROVED PRESS FOR FORMING SPRING SHANKS FOR SHOES.

Emil Briner, New York city.—The object here is to improve and perfect the press or dies for forming spring-shanks for shoes, for which letters patent have heretofore been granted to same inventor under date of February 9, 1875. New devices are provided for perforating the shank blanks and carrying off the punchings, for conveying the sheared-off blanks ready for the action of the shaping dies, and for the purpose of shaping, feeding, and dropping foward the shanks.

IMPROVED DOUBLE APRON.

William G. Heaney, Camden, N. J.—This is an improved double apron, designed for use in male diseases.

IMPROVED VARNISH FILTER.

Jerome Rich, Jackson, Mich.—This is a tube, in the bottom of which is a filter suitable for filtering the dust out of carriage varnish. Below the lower end, which is conical, is a conical cup valve, attached to a rod sliding up and down the tube, to close the filter to prevent any gum or skins from entering it as it passes down to the bottom of the can for filling, also to open the filter and let the varnish in from the bottom of the can. It is intended to draw the varnish from the filter by a liquor thief, the filtering tube meanwhile to remain in the can, and to be corked at the top to protect the varnish from the dust of the atmosphere.

IMPROVED ORE CONCENTRATOR.

Charles Crane and David F. McKim, Parley's Park, Utah Ter.—This invention consists of an endless carrier, slightly inclined laterally, along the upper side of which, near the receiving end, are spouts with fan-shaped corrugations, for distributing the slime in thin layers on the carrier as it slowly passes along. Near the other end are spouts for discharging clear water, for washing the matters received from the other spouts while being carried along under stationary brushes arranged above the carrier for stirring the matters on it. Below the carrier is a sluice for receiving the tailings washed off from the lower edge of the carrier, and at the end is a box to receive the ore. The box is divided parallel to the longitudinal axis of the carrier, to separate the ore into two grades. Directly behind where the ore falls into the box is a perforated pipe for discharging jets of water up to the carrier, for washing off any particles that may adhere to it.

IMPROVED APPARATUS FOR PUMPING SHIPS, ETC.

Charles Huxford, Edgartown, Mass.—This consists of a paddle wheel mounted on a float and dragging astern of the ship, so as to be revolved by the water and having an endless rope fitted around it, and around a pulley on the ship, in such a manner that the rope is made to work the pump, and thus save the working of it by hand in ships not having steam power.

IMPROVED CARTRIDGE BOX.

Charles K. Howe, Hallowell, Me.—This box is so constructed as to allow only one cartridge to be taken out at a time. It may be attached to the shoulder rest of a pocket rifle, or carried in the pocket. It is formed of a ring-flanged block, having holes (for the cartridges) in different radial planes, and covered by a slotted centrally pivoted disk, that has a flange overlapping the flange of block. It is a convenient device for carrying revolver or pistol cartridges, as well as those of rifles and larger fire arms.

IMPROVED SYRINGE.

Reinhold Vander Emde, New York city.—This invention consists in improving upon the ordinary syringe caps, made of soft rubber, by using a centrally perforated exterior cap, provided with a flange that fits around the end, and an interior groove that fits over the rim of the barrel. This offers a better guide and stuffing box for the piston rod, and allows of the same being readily removed for refitting.

IMPROVED DUMPING SCOW.

Daniel Dailey, New York city.—This is an improved dumping scow, from which the refuse may be readily and conveniently dropped for submersion. It consists of a scow divided by a longitudinal center bulkhead and lateral brace walls into compartments, which are each closed by hinged bottom gates that are raised or dropped by chains winding on a top shaft.

IMPROVED METHOD OF UNITING PIECES OF LEATHER, ETC.

George V. Sheffield, East New York, N. Y.—This is a new method of uniting pieces of leather, cloth, etc., by looping an under thread through a loop of the needle thread and drawing the under thread loop up to the surface by the needle thread, thus quadrupling the lower thread in the work, and binding the same by the upper thread, and connecting these quadrupled threads from hole to hole by a thread on each side of the work. The method is mainly designed for uniting boot and shoe soles with a waxed thread.

IMPROVED COMPOSITION FOR DENTAL PLATES, ETC.

Cornelius Reagles, Schenectady, N. Y.—This is an improved compound for dental plates, and for the various purposes for which ivory, gutta percha, and hard rubber are used, which may be molded, pressed, sawed, turned, planed, carved, inlaid, polished, etc., shall not be liable to combustion, shall have great tensile strength, and in the liquid form will make a waterproof varnish of great toughness and brilliancy. The ingredients are pyroxylin, compound ethylated camphor, flexible lac, rubber shavings, Canada balsam, and white wax. The important feature is the combination of india rubber and cellulose.

IMPROVED CENSER.

Rev. James J. Dunn, Meadville, Pa.—This invention consists of a reticulated pocket, for holding the charcoal, with a lamp burner arranged under it for igniting the charcoal more conveniently and maintaining the fire longer than can be done in the close fire pot of the ordinary censer, in which the fire often dies out before the service is over for want of air.

IMPROVED ARTIFICIAL LEG.

Joseph R. Warner, North Dighton, Mass.—This invention relates to an improved knee joint, by which it is impossible for the joint to bend while the weight is upon it. The lower section of the artificial leg is suspended by a sliding strap from the upper section, in connection with a slotted guide band of the detached knee piece, supporting the upper section and causing it to bear tightly on the sliding band when the weight rests on the leg.

IMPROVEMENT IN PLATING METALS.

Charles S. Minchew, Taunton, Mass.—This invention consists in a new process of plating Britannia ware with silver, whereby the ware may be made much harder and lighter and the resonance of solid silver ware imparted to the plated goods. The invention extends generally to the plating of all of the baser metals with the more precious metals, and to the process has been given the name of "impulsic plating," to distinguish it from the ordinary methods of plating. The invention consists, first, in the method of cleansing the articles to be plated by nascent hydrogen liberated by the electric current from a hot alkaline solution; and secondly, in depositing a thin coat of the precious metal, then heating the coated article, and afterwards suddenly cooling it, the steps of depositing the metal, heating, and cooling being repeated in succession until a sufficient thickness of plate is obtained. When the coated metal is first heated, the pores of the base metal expand and a partial vacuum is produced. Atmospheric pressure forces the thin coat of the precious metal into the opened cists, and the sudden cooling produces a contraction of the under metal, which seizes and holds the precious metal that is driven in.

IMPROVED PILL MACHINE.

Jacob Dunton, Philadelphia, Pa.—This invention relates to an improved machine for making pills by compression, and it consists in a movable or detachable compression chamber or powder receptacle, in combination with two movable dies having concaved ends, the upper one of which forms the plunger, and the lower one of which is made short and is adapted to be driven through a hole in a base piece together with the pill. The invention also consists in the construction of the base piece, which is provided with a hole terminating in a laterally discharging curved chute, through which the pill and lower die are driven out of the chamber into a convenient position; and it also further consists in the combination with the powder receptacle of the base piece provided with guides, which permit the powder receptacle to be shifted from its position for compressing to its position above the hole for discharging the pill without misplacement and without the delicate adjustment which would be otherwise required.

IMPROVED DEVICE FOR DETACHING HORSES.

Josephus T. Willis, Pushmataha, Ala.—This consists of locking sleeves, sliding at the ends of the whiffletree to lock or release the catches that retain the traces. The bands are moved by lever-rods connected to a fulcrumed center lever, governed by a forked lever and strap from the carriage. A pin strap extends from the main strap to a hole of the whiffletree, to lock the sleeve and allow the detaching of the traces only after withdrawing the pin.

IMPROVED AIR GUN.

Wilhelm Hebler, New York city.—This air gun is designed to reach the range of an ordinary rifle. The essential feature consists in a novel combination and arrangement of valves and other devices, in connection with the air-compressing chamber, whereby a very large amount of air may be compressed, which by its high expansive force throws the ball a long distance.

IMPROVED PHOTOGRAPHIC PRINTING FRAME.

Claude Léon Lambert, Paris, France.—This invention relates to certain improvements in photographic presses for working off positive proofs from the negative; and it consists in a casing having openings covered with glass of the size and shape of the outlines of the picture, upon which glass openings the negative is placed. A hinged leaf, provided with apertures corresponding to the openings, but a trifle smaller, is then fastened down upon the negative; and the sensitized paper being placed in little compartments above these apertures, a set of little doors, lined with felt, are shut down, and held in place by bearing springs on the lid, which, being fastened, holds the press tightly together.

IMPROVED TRUNK.

William J. Large, Brooklyn, N. Y.—This trunk is so constructed that the tray may be conveniently raised to obtain access to the body of the trunk, which may be conveniently moved from place to place. To the tray are connected vertical slides, which traverse ways in the sides of the trunk, and which support it when lifted above the body of the trunk, to allow access with the latter. There are several ingenious devices connected with this general feature.

IMPROVED ORNAMENTAL LINKS FOR NECKLACE CHAINS.

Shubael Cottle, New York city.—This invention consists in long hollow links, having holes at the ends of the slots of a larger diameter than the end parts of said slots, and having a small plate inserted in one end to receive the ends of the open ring. In this way a strong and beautiful necklace is produced from a comparatively small amount of material, while at the same time it has the appearance of being very heavy.

NEW MECHANICAL AND ENGINEERING INVENTIONS.

IMPROVED PUMP.

George Washington Johnson, Yarmouth, Canada.—This invention improves the construction of the pump known as the Sluthour pump, so as to adapt it to be used on shipboard, and in other places where the pump should work continuously without danger of stoppage or delay from choking. A number of useful improvements are added to allow any obstruction to be conveniently removed from the valves or suction pipe, to enable the pump to work smoothly, to be conveniently sounded, and to admit of an even motion of the pump buckets to be produced when worked by a crank and fly wheel.

IMPROVED GRINDING AND HULLING MILL.

Elam Morrison Query, Harrisburgh, N. C.—This invention consists in constructing a grinding and hulling machine with reversible and, therefore, self-sharpening teeth on the cylinder and concave.

IMPROVED AUTOMATIC STOP MOTION.

Augustus A. Hagen, New York city.—This is an improved automatic stop motion for feed wheels in tobacco-cutting and other machines; and it consists of a fulcrumed lever, that operates by contact with a raised part of the feed screw, a transverse slide piece, and, by a connecting swinging slide, the spring pawl of the ratchet feed wheel, so as to throw the same out of gear.

IMPROVED NUT LOCK WASHER.

Isaac Van Kuran, Omaha, Neb.—This is an improved elastic washer for the nuts of rail joints and similar purposes, and consists of the base plate of the washer, with a large central opening, holding by side lips the elastic top plate in a central position. The device is cheaply made, and the drilling of holes and riveting is avoided.

IMPROVED LOCOMOTIVE ROCKER SHAFT AND BOX.

John T. Crowther, Carbondale, and William J. Crowther, Urbana, Ill.—This invention consists in an open bushing, made in one or two pieces, and provided with three sets of oil holes, in combination with the rock shaft and the box: and in the rock shaft made with three key seats in each end, the key seats in the one end being opposite the centers of the spaces between the key seats in the other end, to enable the shaft to be adjusted in six different positions. It is well known that the rocker shafts of locomotive engines soon wear oblong, which causes a loss of motion to the valves, and a corresponding loss of power to the engine. The present device enables the shaft to be repaired easily and quickly, and without disarranging in the least the valve motion.

IMPROVED PUNCHING AND SHEARING MACHINE.

Austin W. Comstock, Mount Pleasant, Iowa.—This machine is adapted for punching and shearing off flat and round iron, plates, bars, and rods. It consists of two levers fulcrumed to supporting standards, and provided with front jaws, having punch and die for perforating the plate, which is held by hooks of the lower jaw. The rear ends of the levers have square recesses for shearing off round and flat bars.

IMPROVED CRIMPING MACHINE FOR LEATHER.

Chas. M. Robinson and John F. Lister, Newton, Iowa.—The purpose of this invention is to provide a machine for shoemakers' use, to facilitate the work of crimping the leather for the uppers, cutting out the soles, and pressing the same into the proper form to fit the last without lap hammering. The invention consists in a table having a lever pivoted thereto at one end by means of links, and operated at the other end in vertical direction, to produce the necessary pressure by means of a secondary lever, to be worked by hand, which lever carries a crosshead, one end of which is pivoted to the first lever, and the other end to a set of links, pivoted at their lower ends to the table, which arrangement gives a compound motion for the operating lever, between which and the table the crimping, stamping, and pressing devices are contained.

IMPROVED COCK AND FAUCET.

Charles K. Dickson, Jr., St. Louis, Mo.—This invention consists in the combination of a three-armed head with the plug of a three-way cock, in such a way that the said arms may be directly over the openings of said plug, to indicate the position of said openings with reference to the three pipes of the cock. This device, we learn, has already been adopted by the Water Commissioners of St. Louis, Mo.

NEW WOODWORKING AND HOUSE AND CARRIAGE BUILDING INVENTIONS.

IMPROVED DOOR CHECK.

Edsell W. Chamberlain, Sullivan, O., assignor to himself and J. W. Spencer, same place.—This invention consists in forming a reversible door check of two pieces, one of which has a pivot, base-plate, and check studs, and the other a latch and check; the whole to be used in connection with a spring. The device is composed of but two castings, ready to receive the spring and to be applied to doorways without drill, file, or other tool, at very small expense. It serves as a right or left check by simply changing sides.

IMPROVED SASH FASTENER.

Lloyd J. Earll, Pittsburgh, Pa.—This invention relates to certain improvements in that class of sash locks which have an arc-shaped head or binding surface, which bears either against the window sash or is pivoted to the window sash, and binds against the window frame, for the purpose of holding the window sash in any desired position; and it consists in means for tightening a continuous band of leather or rubber about the face of the holder to prevent scratching the paint. The invention also consists in a sliding bolt passing through a lug on said holder, so as to enter a socket of the window frame, and having a shoulder upon one side, so that, when the bolt is in the socket and turned, it cannot be withdrawn. The invention also further consists in the particular form of the socket made to receive the bolt, the same being made in the form of a wedge with a hollow head and flat face, which socket is to be driven into the window frame.

NEW AGRICULTURAL INVENTIONS.

IMPROVED GRAIN BINDER.

Joshua A. Kay, Melbourne, Colony of Victoria.—This is an apparatus for tying knots in single or double string, being mainly intended to be used in grain binders for tying knots in strings around sheaves of grain. The invention consists of certain tools, implements, or devices for tying knots together, with the mechanisms for imparting the necessary motion thereto. These devices consist, primarily, of a prolonged looper, a horizontally sliding hook, a rotating hook, and a hooked finger and thumb; and secondarily, of a needle, a knot slipper, a fixed hook, a top, bottom, and middle cord catcher, a holder, and a cutting knife, by the joint working of all of which inside of an oblong casing or knotting box the knots are produced.

IMPROVED PLOW SHOULDER.

Joseph G. Blount and Elias Haiman, Columbus, Ga.—This consists of a shoulder for the upper end of the plow plate to rest against, which may be adjusted as a longer or shorter plow plate is used, or as the plow plate wears away.

IMPROVED CORN PLANTER.

Charles A. Anderson, Mineral Ridge, Iowa.—This is an apparatus which plants the corn accurately without previously marking the land, and can be readily changed from a self-dropper to a hand dropper, as desired. The new features consist in combining, with a seed hopper having perforated walls and false bottom, a spring having points that pass through and hold the bottom; also, in combining seed plates and crank levers, connected by a rod having pairs of arms, with a rotary wheel having two inclines diametrically opposite and on different sides. The two rims and the alternate arms insure the uniform revolution of the wheel, even when the ground is rough.

IMPROVED CULTIVATOR.

Silas Walton, Moorestown, N. J.—This invention relates to an improved cultivator, so constructed as to pulverize the soil and pass clods and rubbish without clogging, having the blades so extended from the frame and so placed that they lift and pass under the vines and lateral parts of plants, thus allowing the earth to be thrown under them, and so adjusted as to be used as a cultivator only, by pulverizing the soil and leaving it flat, or used as a cultivator and plow combined, by both pulverizing and ridging the soil at the same time, either to or from the rows of plants, as desired. It consists in the combination, with the main beam and hinged arms of a cultivator, of certain standards which are in shape and position curved, downward and outward, terminating at the outward end with a vertically inclined stem, made concave on its upper edge, to carry reversible metallic hoes or blades.

NEW HOUSEHOLD ARTICLES.

IMPROVED BROILER.

Frederic Martin, Jr., West Jefferson, O.—This is an improved culinary vessel, that may be employed for broiling and baking, roasting coffee, and other purposes. It consists in a flat-bottomed case, having a lid with a central hole, provided with a pan having central bottom hole, and having a vertical crank shaft with stirrers thereon.

IMPROVED COMBINED TABLE KNIFE AND SPOON.

James Higgins, Detroit, Mich.—This inventor has arranged a spoon bowl-shaped cavity in the blade of a table knife, near the point, but without destroying the integrity of the edge, point, and back of the blade, so that the latter remains in suitable form for its functions.

IMPROVED HEATING STOVE.

Marius C. C. Church, Parkersburg, W. Va.—This invention relates to certain improvements upon the heating stove, for which letters patent No. 167,497 were granted the same inventor September 7, 1875, and it consists in the particular construction and arrangement of the parts in which the smoke pipe is connected with the back part of the fire chamber, instead of the top, and the upper tapered portion of the heating chamber is expanded into a closed drum, surmounted by a water vessel at the point of exit for the hot air through the detachable cover. An extra back plate of brick or metal forms the back of the fire pot, and a perforated partition of the same material rests thereupon and divides the heating chamber from the fire pot.

IMPROVED MATCH SAFE.

William Dawson, Philadelphia, Pa.—The object of this invention is to provide a convenient receptacle for the stubs or burnt ends of matches. After the match has been used, the disposal of the burnt end is always a source of more or less trouble. It either has to be thrown on the floor, producing in consequence a litter and an unsightly appearance, or it has to be thrown into the stove or carried out of the room, either of which involves more trouble than the insignificance of the object justifies. The invention consists in constructing a match safe with two compartments in the same containing case, one of which is provided with a lid and employed for holding the matches, and the other of which presents an opening through which the burnt ends or stubs are inserted, the said latter receptacle having also a door or slide, through which the accumulated stems may be removed.

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Corner Cutting Machine, Chocolate Mill, Bolt Cutter, Letter Press and Stand—all at Bargains. A. B. Cohu, 197 Water St., New York.

Notes & Queries

W. A.'s query as to radiation does not give sufficient data.—E. C. H. should read our answer to S. O. M., as to supposed diamonds.—J. D. G. will find full information as to the ether ice-making process on p. 228, vol. 34.—A. R.'s communication is founded on a misconception. See pp. 195, 223, vol. 33, as to the nature of electricity.—A. J. R. will find on p. 120, vol. 33, directions for making muslin uninflammable.—C. W. and others ought to know that the only way to find buried treasure is to dig for it.—X. Y. Z. can copper his cast iron articles by following the directions given on pp. 90, 139, vol. 31.—E. F. M. will find full directions for plating with nickel on p. 235, vol. 33. For plating with gold, see p 116, vol. 33. For plating with silver, see p. 362, vol. 31.—A. B. can ebonize wood by following the directions given on p. 50, vol. 33.—W. B. J. can gild his clock hands by the process described on p. 116, vol. 31.—A. G. L. should proceed in zincography exactly as in lithography. The specimen sent appears to be a photo-engraving from a pen and ink drawing.—L. M. M. will find full directions for electro-silvering with a battery on p. 361, vol. 31.—E. D. N. can remove the rust from his sword by the method given on p. 56, vol. 33.—W. D. should read our article on p. 241, vol. 33, on constructing a windmill.—J. C. H., F. A. H., J. H. G., L. N. B., M. G., J. L., S. H. W., P. S., G. D., F. G., J. H. M., C. M., G. G., and others, who ask us to recommend books on industrial and scientific subjects, should address the booksellers who advertise in our columns, all of whom are trustworthy firms, for catalogues.

(1) B. V. P. asks: Please inform me of some way to harden light common iron wire in quantities. A. Box harden it, by the process described in No. 5 of "Practical Mechanism," p. 69, vol. 31.

(2) H. J. W. asks: 1. I am running an old-fashioned high pressure engine. The cylinder is 15 by 48 inches stroke, cut off at half stroke. It has a balance wheel of 15 feet diameter, also a pulley attached, 11 feet in diameter. It takes steam through about 15 feet of 3 inch pipe. The governor is an old-fashioned throttle. I have been running 48 turns per minute, and wish to increase it about 8 turns; but I think the latter is rather too much, as the brasses and journals on main shaft are badly worn. Would it be safe to run her so fast? A. You had better not increase the speed if the bearings are worn. 2. Would it use any more steam to speak of? A. If you run your engine faster, you will use more steam in proportion. 3. Would I have to run the governor faster or slower? A. Run it slower.

(3) O. M. B., of San Juan Bautista, Mexico.—If you reduce the speed of your engine you reduce the power, unless, as you propose, you increase the steam pressure. It would probably be better to alter the size of the gearing, thus using the same steam pressure and same piston speed, and to decrease the speed of the rollers; while their power will be proportionately increased.

(4) W. S. says, in reply to the query: How is it that *minus* multiplied by *minus* gives *plus*, and *plus* multiplied by *minus* gives *minus*? By trigonometry, the cosine of any arc divided by its sine is equal to its cotangent. Take the arc of 135°: $\frac{-\sqrt{.5}}{\sqrt{.5}} = -1$. Clearing of fractions, $-\sqrt{.5} = -1 \times \sqrt{.5}$. That is, a *minus* quantity is equal to a *minus* quantity into a *plus* quantity, which was to be proved. The secant of any arc is equal to 1 divided by the cosine. $\frac{1}{-\sqrt{.5}} = -\sqrt{2}$ Clearing of fractions, $1 = -\sqrt{2} \times -\sqrt{.5}$. That is, a *plus* quantity is equal to a *minus* quantity into a *minus* quantity. A. This is an illustration which might possibly be admissible, if at all, only in the higher analysis, but would be obviously out of place for establishing the fundamental principles of elementary analysis.

How far is the earth from the sun, as estimated recently by the transit of Venus? A. The observers have not got that far, we imagine. Indeed, we noticed that, at the last meeting of the British Association, one of the members stated that he thought they would be doing very well if they worked up the observations in seven years.

(5) R. S. N. says: 1. I have a turning lathe operated by a treadle attached to the shaft of a 36 inch wheel of 4 inches face. The treadle cranks make 6 inches sweep; the bearings are ⅞ x 2¼ inches. The chuck spindle bearings are ⅞ x 2¼. A. Such a lathe will require about ½ horse power. 2. What do you think of this arrangement? A. It is a powerful lathe to be worked by the foot.

(6) S. M. says: 1. A line joins two fixed points on the earth's surface. Presuming that no earthquake or any other convulsion has affected these points, will time produce any change in the direction of this line? Can it point due north today, and 1° or 2° east or west of north a few years hence? A. No. 2. In other words, if two surveyors state its direction differently, an interval of time intervening, can you predicate error of either or both? A. If we knew by what method the surveyors determined the astronomical meridian and applied it to the line above spoken of, we should probably be able to predicate the error of one or both.

(7) B. K. A. asks: Will you let us know what is the difference between a high pressure and a low pressure engine? A. A high pressure engine exhausts the steam when the piston has arrived at the end of the stroke. A low pressure engine condenses the steam, and thus has live steam on one side, and a partial vacuum on the other side, of the piston.

(8) E. R. says: I propose to build a yacht 90 feet long and of 18 feet beam, to draw 12 inches of water when light, and not to exceed 18 inches with all machinery and 6 tuns of coal on board. I intend to use two engines 8 x 10 inches (to work quartering), two upright boilers of 36 inches diameter, with 75 tubes, 1¼ inches in diameter and 4 feet long. Fire grate surface is 2½ feet x 3½ feet in each boiler. I will use the best propeller I can find, and fully submerge the same under the boat without loading down the boat. What kind of a sea boat will she be? A. We do not think such a boat would stand rough weather very well; and for smooth water it might be advisable to use side wheels.

(9) M. M. C. says: We are putting in a 50 horse power engine which will run at 85 revolutions of the crank per minute. The drive pulley is 4 feet in diameter; distance to main shaft is 15 feet. What should be the width of the leather drive belt? A. About 12 or 14 inches.

(10) A. C. asks: How many times more water will go through a 3 inch pipe than would through a 1 inch pipe? A. The question is too indefinite to admit of a single answer. If the velocity in each pipe is the same, the discharge will be in proportion to the squares of the diameters. If the head is the same for both pipes, and the pipes have the same length, the velocities will be different and the discharge will vary as the products of the velocities by the squares of the diameters. We give below Weisbach's rule for determining the velocity: Let l=length of pipe in feet, d=diameter of pipe in feet, v=velocity of flow in feet per second, and h=head of water in feet. Then

$$v = 8{\cdot}02 \times \sqrt{h} \div \sqrt{1{\cdot}505 + \left(\frac{0{\cdot}01439 + 0{\cdot}017155}{\sqrt{v}}\right) \times \frac{l}{d}}$$

(11) J. W. G. asks: What is used in the navy for blacking boilers? A Paint made of common charcoal ground in oil is an excellent article for the purpose.

(12) T. W. R. asks: 1. Will steam after heating a building, return to the boiler, no matter how much pressure you may have in the boiler, that is, will steam return against 20, 40, 60 lbs. of steam? A. It can be made to return, by the use of a suitable trap. 2. Is the pressure equal on all sides of a boiler? A. The pressure is greatest on the bottom, on account of the weight of water in the boiler. 3. In low pressure boilers, could not the return be run half way below the water line as well as at the bottom of the boiler? A. An arrangement of this kind is not uncommon.

(13) R. S. Jr. asks: Will my engine, the cylinder of which is 2¾ inches bore by 5½ inches stroke, drive a back-geared engine lathe of 16 inches swing and 5½ feet bed? A. Your engine and boiler are both rather too small for the purpose.

(14) J. & C. say: We have a stationary engine of 16 inches diameter, 5 feet stroke, using steam from 90 to 100 lbs., and cutting off at 10 to 12 inches on the stroke, as the work requires. The fly wheel is 20 feet in diameter, weighing 18,000 lbs., made in 8 sections and held together at periphery with wrought iron key and links. The center is held by two flanges bolted together through the arms. Would it be safe and economical to run the engine at 35 revolutions per minute? A. Yes, if the bearing surfaces of your engine are sufficiently broad and strong to stand the wear and tear.

(15) W. E. P. says: For extinguishing kerosene flames, I would recommend ashes from the stove. When the flames were 4 feet high, cold ashes from the stove extinguished them immediately.

(16) A. M. T. asks: 1. Has the pump, used on locomotive engines, suction? A. Yes. 2. Are the air pumps, used on ocean steamers, ever made of brass or steel? A. Brass.

(17) W. T. H. asks: Why is it darkest just before dawn? A. The statement to this effect is without foundation.

(18) S. asks: Does cast iron contract or expand when cooled from a liquid state? A. Iron acts very much, in this respect, like water. Solid iron floats upon the molten metal and is consequently lighter. As molten iron cools, within certain limits, it gradually expands; but when it has reached a certain temperature, it begins to contract, and this it continues to do however low the temperatures may be carried. It is for this reason iron copies so accurately the molds into which it is poured while in a molten condition, and allowed to gradually cool.

(19) J. McC. asks: How are pictures produced on white porcelain glass cone shades? A. They are for the most part put on by the decalcomanie process.

What is the coloring principle in ruby-stained window glass? A. Purple of Cassius.

(20) J. A. G. asks: What can I use on or in a rubber hose to prevent kerosene oil from rotting it, or what flexible material can I use in place of rubber to draw kerosene from a large tank? A. There are several methods by which the tube may be protected completely or in part; but we should recommend, as liable to give the best satisfaction, the use of a good tube of leather of sufficient suppleness to avoid the objectionable tendency to close the duct by creasing, when bent at a moderate angle.

What is the best material to use on boots that are exposed in water a great deal? A. Try a solution of india rubber in bisulphide of carbon.

(21) J. W. says: I had occasion to remove a piece of mica from a stove, and noticed that, on being crushed, it gave out flashes similar to those noticed on scooping hard sugar with a metal instrument. Can you give an explanation? A. The flashes of light are due to the electrical disturbance consequent upon the forcible disruption of contiguous laminæ. It is a well known phenomenon.

(22) P. asks: What will prevent the pigment permanent white from scaling off parchment? A. Try the following: Reduce to powder and dissolve quickly in cold water a quantity of gum tragacanth. There must be sufficient water to give to the diluted gum the consistence of a jelly. Mix with this your pigments (sulphate of baryta), and, after finishing the work, spray with a little naphtha in which has been digested for some time a quantity of caoutchouc. The naphtha will soon evaporate, leaving behind the caoutchouc as an extremely thin and adhesive, but perfectly transparent, film.

(23) A. L. E. says: A friend of mine states that, to be able to run an engine in a small building in New York city, the engineer must have a certificate showing that he has the ability to run the engine. I say that he does not need it. Which is right? A. Your friend's statement is correct.

(24) A. C. McK. asks: 1. Is tellurium valuable? A. Yes. 2 Is it difficult to extract? A. Very. 3. Is there any market for the ore or the metal in America? A. The market will have to be made, since, owing to the scarcity of the metal, it has as yet been little employed in the arts. 4. What is the probable cost of extraction per ton? A. The cost will have to be determined by trial.

(25) R. J. P. asks: Can ordinary Indian ink have anything added to it to make it indelible? A. Try the addition of a little nitrate of silver just before using.

(26) A. C. McK. asks: How can I extract tellurium from its ore? A. Professor von Schroetter has lately published the following method of separating tellurium in its free state: The finely crushed ore is first digested with strong hydrochloric acid (in order to decompose or dissolve the sulphides of arsenic, antimony, lead, etc.), and separated from the insoluble residue, which is then treated with *aqua regia*, when gold and tellurium are dissolved, and thus separated from silver. From the solution thus obtained the gold is precipitated by protosulphate of iron, and the tellurium by metallic zinc. The gold is melted in a graphite crucible with borax, and the tellurium in an iron pot, when both metals are obtained in a pure state, the latter being a white metal of from 6·0 to 6·4 specific gravity and of great fusibility. The present value of tellurium (fused) is about $200 per lb. avoirdupois.

(27) W. L. S. asks: Can you tell me of a safe way of preventing mildew in cotton duck sails, etc.? A. We find the following recorded as a good preventive of mildew: Boil the fabric for several hours in a solution consisting of 50 parts common salt, 4 parts lime, and 1 part alum, dissolved in a suitable quantity of clear water.

(28) A. B. O. says: I find the following alloy to answer for repairing the damage to steam chests, valves, etc., which have been eaten out and honeycombed by the use of impure suet, tallow, and other bad oils: First make molds of Russian sheet iron, bent at right angles where surfaces or corners are to be built up, stopped with red molder's clay or plaster. Clean the surfaces: and if there is no hold for the alloy, small holes must be drilled in the iron to secure the casting in place. The alloy consists of 2½ parts copper, 1½ parts antimony, and 6 parts tin. Heat the casting in a common ladle to dull red, and file the mold. The alloy cannot be worked down with anything but file and scraper. I have saved with this alloy a couple of steam chests which would have cost $500 to renew in a short time.

(29) T. H. W. asks: Is there any instrument, similar to a thermometer, for indicating the degree of purity of the air? A. This desirable little instrument has not yet been invented; and from the numerous obstacles to be overcome, it is not probable that anything of practical utility in this line will ever be devised.

(30) M. R. asks: How can I make ink to write blue, and afterwards turn black? A. For blue ink changing to black, take ¾ lb. finely powdered nutgalls, and digest for 2 or 3 days in 1 gallon of cold water; add to this about 6 ozs. each of finely powdered copperas, gum arabic, and sulphate of indigo (chemic or Saxony blue). Heat the whole to the boiling point, and allow to stand with occasional stirring for several days in a warm place. Then filter through a fine linen cloth, add a few cloves, and bottle for use. To make the so-called sulphate of indigo (Saxony blue): Dissolve well sifted indigo in 5 times its weight of strong oil of vitriol, previously heated over a water bath to about 150° Fah. Neutralize the solution by cautious additions of carbonate of potassa in the form of a fine powder. Collect and dry the precipitate.

(31) M. C. asks: How can I dress Arkansas diamonds? A. With copper wheels, and emery or corundum.

(32) C. asks: Which is the best soap for the toilet, and which for washing clothes? A. Use for the toilet a good variety of glycerin soap. The common yellow soap answers well enough for laundry purposes.

1. Is there an alloy that resembles gold, and is as hard as 14 carat gold after it is annealed? A

Try the following: Copper 88·4 parts, zinc 12·2 parts, tin 1·4 parts. Fuse the copper first, and then add the other metals. 2. Is there a brass solder that will fuse as easily as 12 carat gold solder? A. Try 1 part silver and 2 parts brass.

(33) L. L. L. asks: Has the author of articles, which have been published in and paid for by literary periodicals, a right to publish the same in book form? Or does the property in said articles vest in the publishers of the periodicals, making it necessary for the author to obtain permission from them to publish such book? A. The right to republish articles in book form depends on the agreement between the author and the publisher.

(34) C. F. asks: Can common red earthenware be, by any process, glazed white either before or after the lead glazing? A. Fabrics of potter's clay are too fusible to admit of being enameled with porcelain. Try the following: Mastic 10 parts, red lead 60 parts, calcined tin (putty powder) 26 parts, and common salt 10 parts. Mix them, and calcine and powder the composition three or four times. Apply to the ware (after baking) in the manner of a paint, and place again in the oven.

(35) J. M. says: I am using a cast iron pot in galvanizing, and have been told that the zinc in connection with the cast iron pot forms more slag by galvanic action than a wrought iron pot would. Is this so? A. No.

(36) F. P. asks: 1. Can the color of coal tar be changed conveniently to a red or brown, or any other color that would be suitable to paint farm buildings, without changing its nature? A. No. Use red ocher or red lead. 2. How can coal tar be thinned? A. Use naphtha.

(37) E. D. says: I have a pack of playing cards that stick together when affected by the heat of the hand, and seem to get dirty very quickly. Can you inform me of any preparation to prevent their sticking and to give them a gloss? A. The trouble is due to the inferiority of the glazing with which the cards are enameled. We do not think you can overcome the objection without the expenditure of too much time and labor.

(38) J. G. M. & Co. say: In cooking fish for canning, we need a greater heat than 212° Fah. gives us. We have used salt, and then chloride of calcium, heating the water by steam. But the oil from salmon, mixing with the calcium, is hard to clean off the cans after cooking. Can you tell us of some cheap preparation which we can heat (with steam coils) to 240° Fah.? A. It would be better to heat the water to the requisite temperature by means of a very moderate steam pressure. The temperature of the boiling point might thus be arranged to suit your convenience, and by suitable valves caused to remain constant. Saturated saline solutions are objectionable.

(39) J. M. A. and others.—It is a popular idea that the sunflower will prevent disease, but we have no reliable authority for the statement. It is not used in medicine.

(40) H. W. H. asks: Is it possible to blow glass in the shape of a cylinder, with a very small opening along one side? A. Yes; it is readily done. The molten glass, as it is drawn from the pot, adhering to the end of the *punta* tube, is blown into a pear shape, elongated by swinging, rolled on a steel slab into the cylindrical form, and slit through lengthwise, and the cone-shaped bases at both ends removed. It is then placed in the annealing furnace.

(41) M. F., of Gaggenau, Germany, asks: Is there a good gas tight membrane, not affected by heat or water, or by the impurities (acids, etc.) contained in the gas? A. This desirable invention has as yet been very imperfectly realized.

(42) M. W. asks: How are rain gages generally constructed? If a vessel 12 inches in diameter above, and 10 inches at the bottom, and 8 inches deep, should be filled with rain water to depth of 3 inches, would 3 inches really have fallen, or more? A. Less. If the vessel employed as the receiver is not a uniform tube, it should be carefully graduated before using.

What will remove the marks of so-called indelible ink from linen? A. Use a strong solution of cyanide of potassium in water. As the cyanide is very poisonous, it is necessary to avoid contact with sores or cuts in the flesh.

Do the crossheads of a locomotive make a retrograde movement when the engine is going either forward or backward, unless the driving wheels slip? A. No.

(43) H. J. asks: Will oil evaporate into the air and dry away, whether on the surface of water or not? Can water evaporate into the air when its surface is covered with oil? A. The application of a film of any of the fatty non-drying oils to the surface of water will prevent its evaporation. The oil itself is not volatile.

(44) F. N. B. says: I have been trying to make a friction match composition by a formula in which there is a large proportion of niter. The niter spoils the composition; the matches are good when first dried, but an exposure to damp causes them to become sticky, so that, when placed in a cellar they will in 24 hours stick to my fingers like tacks to a magnet. When kept in a dry place, the phosphorus slowly burns off, filling the room with a strong garlic odor, and the matches are worthless. What is the matter? A. After preparing the matches, and while dry, dip the tips into a moderately strong collodion for a moment, and allow to dry. This will form a thin protecting film over the friction composition. This film is not affected by moisture or other atmospheric influences, and does not interfere with the ready ignition of the match when required, as the slight abrading influence of the friction is sufficient to remove the film, while in itself it is a very inflammable substance, and aids, by the heat of its combustion, the ignition of even a common wooden splint.

(45) W. S. H. asks: Is it possible to become sufficiently advanced in architecture without a tutor, to enable one to complete the study in a short time under instruction? A. It is necessary to take an extended course of study in the office of an architect of experience, where you will have access to his library.

(46) S. M. O. and others.—The diamond occurs in the form of rounded pebbles covered with a brownish crust. Its crystals are in the form of the regular octohedron, but their faces are often a little convex. It has the most remarkable refractive and dispersive action upon light, is a nonconductor of electricity, and is not acted upon by acids or alkalies. If the stone is a diamond, it will easily scratch corundum and quartz, and will have a specific gravity of from 3·52 to 3·55. The specific gravity of quartz crystals is from 2·50 to 2·66, while that of corundum, true sapphire, etc., is from 3·9 to 4·16. A diamond dealer alone could give a valuation, based on personal examination.

(47) F. S. & S. ask: What is the best mode of cleansing the feathers of an eagle, which are discolored by fly dirt and dust? A. Use freshly prepared lime water. It may require several applications and an exposure of several days to perfectly cleanse the feathers.

(48) A. H. S. asks: Does nitro-glycerin lose any of its explosive force when combined with earth to form dynamite? A. The nitro-glycerin itself remains unaltered in the mixture, but, as might be expected, the dynamite is a much weaker explosive, volume for volume, than good nitro-glycerin.

(49) A. H. asks: Will it injure the burning properties of kerosene, or make it any more or less explosive, to filter it through cloth or bibulous paper to remove sediment? A. It will alter neither its illuminating nor its explosive qualities.

(50) C. B. F. W. asks: How can I test laundry soaps for adulterations, such as silex, silicate of soda, soapstone, etc.? A. Dissolve a small quantity of the soap completely in a large excess of boiling water, and filter through clean white filtering paper. Observe whether or not any insoluble inorganic residue remains behind on the filter; if so, examine it with a strong magnifying glass, and, if the particles appear to be homogeneous in character and transparent or translucent, the adulterant may safely be presumed to consist of quartz sand. If opaque, and of a pearly or dark color, it is probable that the material consists of talc, chalk, soapstone, barytes, or some of the other numerous and common adulterants. In order to be sure that part, at least, of the residue does not consist of resinous or other organic materials, the residue should be heated to bright redness for some time before examination with the glass. To test for the presence of water glass, add (to the filtrate from the above experiment) a small quantity of muriatic acid, heat to boiling, and allow to stand for some time. If a precipitate forms, wash it several times with clean water, heat it, and examine it as before.

(51) G. J. B. says: What effect on the acoustic qualities of a room would a cove in a ceiling have, the room being 90 x 47 feet, and 27 feet high? The cove is 4 feet out from the side walls. A. It is not likely that so small a cove would affect the acoustic qualities of the room.

(52) F. P. says: I read that Governor Bagley, of Michigan, suggests that all land owners should plant a tree during this our centennial year What kind of tree would be most suitable as a shade and ornament tree, an evergreen being preferred? A. The Norway spruce fir is a good evergreen for this purpose; the scarlet maple or the sugar maple is a good ornamental shade tree among the class not evergreen. The elm is also one of the noblest trees of the latter class.

(53) F. R. asks: How many Bunsen cells are necessary to effect the decomposition of water, with moderate rapidity? A. Two or three cells will evolve has readily from acidulated water.

(54) C. K. M. asks: 1. Will ¼ lb. No. 16 cotton-covered copper wire, for a primary coil, and 1 lb. No. 23 cotton-covered wire for the secondary coil, and 1 cup of Callaud battery, do for giving electric shocks? A. Yes. Stronger shocks would be obtained if smaller wire were used for the secondary. 2. How thick ought the bundle of iron wires to be for such a coil? A. About ½ inch.

(55) J. L. W. asks: In taking a gun barrel and holding it perpendicularly, and taking a compass, holding it on the side of the same and lowering it to the breech, the needle will suddenly reverse when lowered about half way; and on raising, it will again reverse at about the same place. What is the cause of this change? A. In such a position the gun barrel is almost in the line of the dip, consequently it will become magnetic from the inductive action of the earth. The lower end will be a south pole, the upper a north pole.

(56) W. H. G. says: I have made an induction coil, 6 inches long by 1¾ inches diameter, with a half inch core of iron wires, using 2 turns of No. 22 cotton insulated cooper wire for the primary, and about 25 turns of No. 32 cotton insulated copper wire for the secondary coil, making the latter about 20 times as long as the primary. The vibrator is attracted by the core, and works well. I have insulated the two coils from each other with 3 sheets of paper varnished with shellac, and put 1 sheet of varnished paper between each two turns of the secondary. With the above I only get feeble shocks on holding the two ends of the secondary wire on my tongue, using 7 cells of the gravity battery in connection with the primary. A. It is quite likely that different convolutions of the secondary touch somewhere, and by this means the greater part of the action is cut off.

(57) J. B. J. says, in answer to several correspondents who ask as to how the variation of the magnetic meridian is reckoned: There is a secular change, increasing or diminishing the declination from 1° to 7', annually, according to locality. There is an annual change, affecting the needle about twice as much in summer as in winter. There is a diurnal change, during which the declination attains its maximum or minimum about 2 P. M., according as it is W. or E.; and there are also irregular changes, depending upon the condition of the atmosphere, magnetic storms, etc., as well as local attraction, proximity of iron, ore, steel, etc. It must be evident to any one conversant with the subject that it is practically impossible definitely to locate a line with a given bearing from the meridian, with a surveyor's instrument, unaided by some external object. The only reliable method of determining the angle, if any, between the line in question and a true meridian, would be to set up a surveyor's instrument over, say, the south end of the line, sight to the pole star at its extreme elongation, and drive a stake in the range thus found as far off as can be observed conveniently, and repeat the process for the extreme western elongation: midway between the two stakes is the true meridian from the instrument. The distance from the midway point to the line in dispute, divided by the distance from that point to the instrument, will be the line of the angle between the line and true meridian. As the operation will doubtless be performed after sunset, the sights or crosshairs of the instrument will need to be illuminated by light of lamp reflected upon them from a white object. A lamp or candle may be used to determine points at which to drive stakes.

(58) W. M. R. says, in reply to P. A. K., who asks who invented the first railroad sleeping car: In 1838, when I was chief engineer of the Cumberland Valley Railroad, between Harrisburgh and Chambersburgh, Pa., we had sleeping cars built, which ran for some years. One end of the car was arranged in the ordinary way, with day seats; the other end was fitted up with eighteen sleeping berths, for the night, which were changed, for the day's running, so as to make omnibus seats on each side of the car. There were three lengths of berths and three tiers on each side. The top tier of berths hoisted on a hinge, and was secured by rope supports to the ceiling of the car. The middle tier consisted of the back of the omnibus seat, hinged and supported in the same manner. The lower tier was the day seat along the side of the car. At that period, there were two coach loads of passengers arriving by turnpike road nightly from Pittsburgh; and they were very glad to have the benefit of the sleeper during the four hours then occupied between Chambersburgh and Harrisburgh, on the old plate rail. There was no charge for sleeping accommodations.

(59) A. H. says, in answer to C. E. A.'s query as to a difficulty with his alarm bell: I think it arises principally on account of the brevity of the contact between the hammer and bell. If so, he can ascertain the fact by pressing the hammer against the bell by hand; to this the armature ought to respond. In such case, the remedy would be to place the wire now attached to the bell in contact with a piece of metal, so arranged that the hammer will be in contact with it, at each vibration, a length of time sufficient for the magnet to act.

J. S. J. says: Water is forced into all parts of our building by its own pressure, through iron pipes. Frequently is heard a loud singing noise like air escaping slowly; but after the spigot is opened and the water runs freely, the noise continues about a minute. What is the noise?—E. M. H. asks: I have an open buggy of 5 feet track, front wheels 3 feet 11 inches high, and hind wheels 4 feet 1 inch. What is the necessary under axe?

COMMUNICATIONS RECEIVED.

The Editor of the SCIENTIFIC AMERICAN acknowledges, with much pleasure, the receipt of original papers and contributions upon the following subjects:

On the Aeroscope. By W. S. H.
On French Apartment Houses. By N. L. D.
On Life and Blood. By J. F. G. M.
On a Telescopic Eye. By ——.
On a Book on Geology. By E. K.
On the Hidden Forces of Nature. By H. F. G.
On Public Works. By J. C. W.
On the Financial Question. By W. H.

Also inquiries and answers from the following:

J. H. H.—S. F. S.—L. S. W.—M.—W. H. H.—J. M. M.—J. S. T.—B. B.—F.—F. W.—R. B. G.—Q.—N. W.—I. J.—E. R. G.—R. McM.—W. L. S.

HINTS TO CORRESPONDENTS.

Correspondents whose inquiries fail to appear should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them. The address of the writer should always be given.

Enquiries relating to patents, or to the patentability of inventions, assignments, etc., will not be published here. All such questions, when initials only are given, are thrown into the waste basket, as it would fill half of our paper to print them all; but we generally take pleasure in answering briefly by mail, if the writer's address is given.

Hundreds of inquiries analogous to the following are sent: "Whose is the best brick-making machine, and what is its price? Who makes coiled springs to order? Who buys sulphate of lead? Who sells wire-straightening machines? Who makes vegetable parchment? Who are the principal lumber dealers in New York city? Who makes bung machines?" All such personal inquiries are printed, as will be observed, in the column of "Business and Personal," which is specially set apart for that purpose, subject to the charge mentioned at the head of that column. Almost any desired information can in this way be expeditiously obtained.

[OFFICIAL.]

INDEX OF INVENTIONS

FOR WHICH

Letters Patent of the United States were Granted in the Week Ending

March 14, 1876,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

A complete copy of any patent in the annexed list, including both the specification and drawings, will be furnished from this office for one dollar. In ordering, please state the number and date of the patent desired, and remit to Munn & Co., 37 Park Row, New York city

Advertisements, exhibiting, J. H. Crane..... 174,621
Air, compressing, W. D. Seal... 174,660
Alarm, burglar, Allen and Lathrop..... 174,754
Auger, earth, J. D. Harris..... 174,615
Axle grease, W. Peters 174,738
Axles, setting metal, F. Bex (r) 6,997
Baby walker, combined, J. Erikson..... 174,793
Bag holder, Roush and Sarver..... 174,858
Bag, seed, J. R. Hamilton..... 174,672
Bale tie, J. S. and C. R. Herron..... 174,730
Bale tie, cotton, P. Slattery..... 174,707
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Buckle, G. H. Palmer..... 174,844
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Car coupling, J. B. Corey..... 174,788
Car coupling, P. Hien..... 174,676
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Car fastening, dumping, J. W. Marden 174,638
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Car, refrigerator, A. T. Nafis..... 174,831
Car, refrigerator, J. H. Wickes..... 174,882
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Grate, J. W. Williams..... 174,650
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Gun carriage, L. W. Broadwell..... 174,770
Guns, machine, J. P. Taylor..... 174,872, 174,873
Gun, magazine, W. Gardner..... 174,798
Gun tool combination, A. E. Barthel..... 174,759
Harrow, wheel, Bramer & Badger..... 174,76

Harvester, W. R. Baker	174,756
Harvester, W. Fosket	174,623
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Pocket book fastenings, D. M. Read	174,730, 174,740
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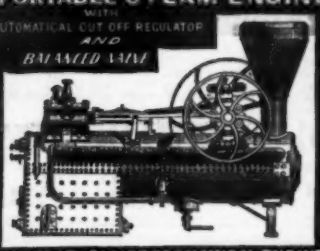

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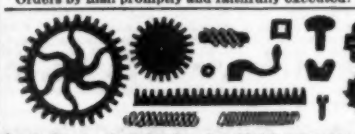

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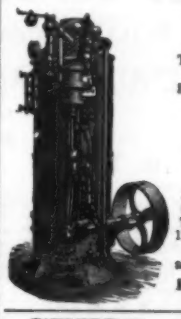

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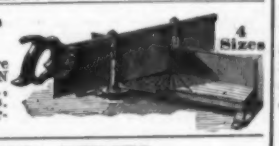

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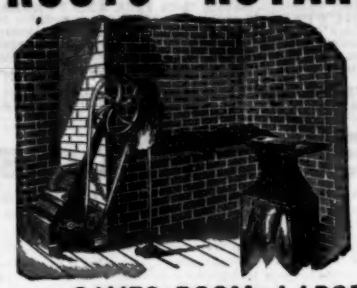

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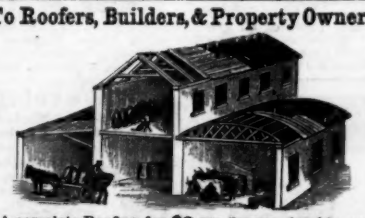

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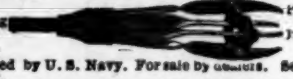

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